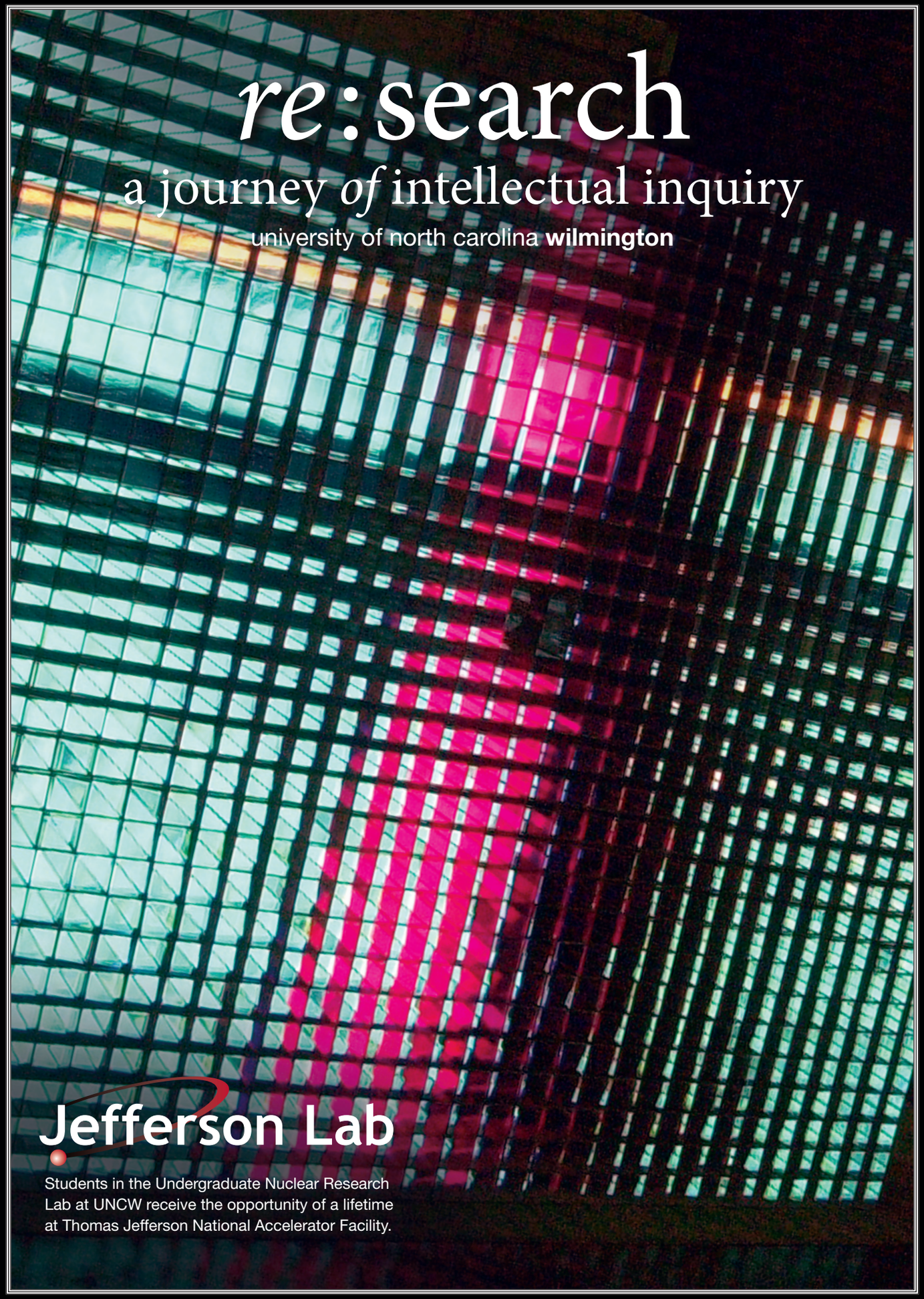


re:search

a journey *of* intellectual inquiry

university of north carolina **wilmington**

Jefferson Lab

Students in the Undergraduate Nuclear Research Lab at UNCW receive the opportunity of a lifetime at Thomas Jefferson National Accelerator Facility.

BOTH UNDERGRADUATE AND GRADUATE STUDENTS ARE CORE PARTICIPANTS IN UNCW RESEARCH


UNCW/JAMIE MONCRIEF

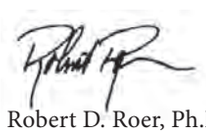
Long recognized for its research in the marine sciences, this issue of UNCW *re:search* highlights new, exciting developments. Our capabilities to conduct cutting-edge research and partner with the private sector will be greatly enhanced by a $15 million construction grant from the National Institute of Standards and Technology for a new marine biotechnology building that will be the first for our millennial campus. We report that UNCW and Florida Atlantic University successfully competed for a 5-year, multi-million dollar grant to be designated as a National Oceanic and Atmospheric Administration Cooperative Institute. The new institute will replace the National Undersea Research Centers on the East Coast.

Significant research is going on in disciplines that may not come to mind when thinking of UNCW. Our cover story is about nuclear physicist Liping Gan, one of five leaders for the PrimEx Collaboration, a 70-member international team, studying subatomic particles and quantum chromodynamics. Supported by the National Science Foundation, Gan conducts her research at the Thomas Jefferson National Accelerator Facility in Newport News, Va.

UNCW professors Karl Ricanek, Jr., Midori Albert and Eric Patterson comprise the Face Aging Group. They and partners in three other U.S. universities constitute the new Center of Academic Studies in Identity Science (CASIS), a pilot project funded by the Office of the Director of National Intelligence to support research and training in biometrics and facial recognition.

That these opportunities provide powerful learning experiences is attested to by undergraduates Erik Minges '10 and Margaret Schneider '11 (page 12) – who had the opportunity to work with professor Gan at Jefferson Lab. Excitement and pride is also evident in the faces of Brandon Hilton '11, Phillip Whisenhunt '10 and Ricardo Valea '10, undergraduate members of the Face Aging Group (page 19) and extends to students from other campuses engaged in our summer Research Experiences for Undergraduates program (page 8).

Much of the research at UNCW would not be possible without the dedication and tireless work of our graduate students exemplified by Ph.D. candidate Christy Visaggi (page 5). The success of the research endeavor at any university depends upon the ability to recruit and retain the best and brightest graduate students. As state funds are reduced during these challenging economic times, it is increasingly difficult for UNCW to assemble competitive financial packages to attract the most outstanding graduate students from across the nation. We seek your help to provide support for the well-being of our graduate programs. Funds will be used for graduate student scholarships and travel funds. Please visit **www.uncw.edu/gradsupport** to see the opportunities that are available. Thank you.



Robert D. Roer, Ph.D.
Dean of the Graduate School and Research

UNCW

*re:*search a journey of intellectual inquiry

to explore or examine
in order to discover

Fall 2009

re:search is produced by UNCW Marketing and Communications for the

University of North Carolina Wilmington

Office of Research Services and Sponsored Programs

601 South College Road
Wilmington, NC 28403-5973
910.962.3810

www.uncw.edu/research

re:search
a journey *of* intellectual inquiry

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Publishers
Robert D. Roer, Ph.D.
Dean Graduate School and Research

Stephen S. Meinhold, Ph.D.
Associate Dean of Research

Editor
Kim Proukou '06M

Contributing Writers
William Davis '08M
Lindsay Key '11MFA
Brenda Riegel

Copy Editors
Autumn Bean '10UH
Marybeth Bianchi
Andrea Weaver

Creative Director
Kyle Prey

Designer
Kyle Prey

Photographer
Jamie Moncrief

Printer
Theo Davis Printing

Production Editor
Jamie Moncrief

Web site
Lindsay Key '11MFA

Cover Photographer
Jefferson Lab
Greg Adams, DOE

Cover Illustration
Kyle Prey

Correspondence: Editor, *re:*search
proukouk@uncw.edu

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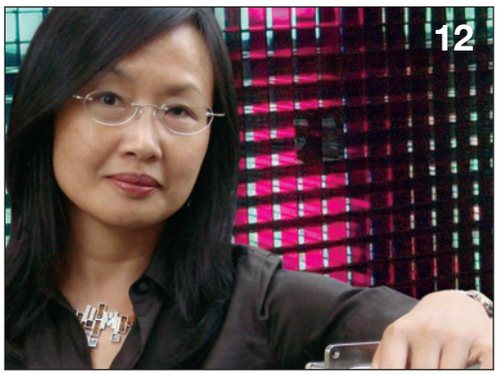


12 PHYSICS: THE RULES OF THE GAME

UNCW'S Liping Gan, associate professor of physics, creates powerful learning experiences for students at the Thomas Jefferson National Accelerator Facility in Newport News, Va. One of five leaders of the 70-member international PrimEx Collaboration, Gan investigates questions as big as the origin of the universe – in spaces as small as the interior of the nucleus of an atom.

by Kim Proukou'06M

FEATURES

19 MORE THAN JUST A FACE

Karl Ricanek, Jr., associate professor of computer science and director of the Face Aging Group at UNC Wilmington, is an expert in face and age recognition. In February 2009, the Office of the Director of National Intelligence (ODNI) designated UNCW as one of four universities to form a new Center for Academic Studies in Identity Sciences (CASIS), a Center of Academic Excellence (CAE).

by Lindsay Key '11MFA and Kim Proukou '06M

22 WASTE NOT, WANT NOT

Biologist Larry Cahoon is set to revolutionize hog waste management in North Carolina with pink lagoons. "No odor at 50 yards" is quite an achievement, but better yet, the by-products of hog waste may open whole new markets as well as produce industry-wide incentives for the use of best-practices in hog waste management.

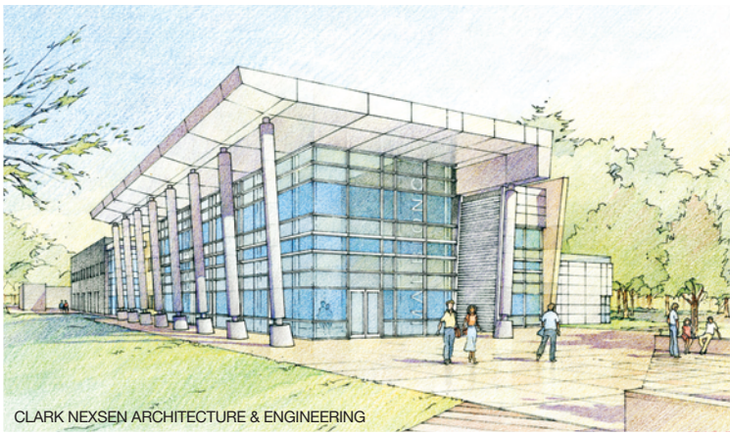
by Brenda Riegel

24 WATCHING OVER ONSLOW BAY

Biologist Ann Pabst and research associate Bill McLellan direct UNCW's aerial survey program. The role of this collaborative bio-monitoring program is to collect the highest quality data on marine mammal and sea turtle distribution in Onslow Bay. Observations will be used to design measures to protect 43 marine species of concern that occupy these waters – including endangered and protected marine mammals and sea turtles.

by Lindsay Key '11MFA

DEPARTMENTS



CLARK NEXSEN ARCHITECTURE & ENGINEERING

A STATE OF THE ART, RESEARCH-TO-PRODUCT FACILITY

The National Institute of Standards and Technology has awarded the University of North Carolina Wilmington's Center for Marine Science (CMS) $15 million for construction of a new marine biotechnology facility. The facility will be home to the Marine Biotechnology in North Carolina **(MARBIONC)** program. The state of the art, research-to-product development center will be built on the campus of the Center for Marine Science. Construction is expected to be complete by summer 2011. Announced in July 2009, the cost-share award represents 50 percent of the estimated $30 million construction cost.

This award is funded under the American Recovery and Reinvestment Act of 2009, informally known as the stimulus bill. The purpose of the act is to support innovation and discovery at respected universities and bring economic benefit to the localities that support them. Proposals were evaluated on scientific and technical merit, demonstrated need and quality of building design.

"The global biotechnology market is expected to top $226 billion by 2010. Ten percent of that includes various areas of marine biotechnology – from toxins and therapeutics to mariculture," says **Daniel Baden**, director of CMS and executive principal for MARBIONC.

"Over 50 percent of the drugs in the U.S. today are derivatives of natural products," says **Jeffrey Wright**, Carl B. Brown Distinguished Professor of Marine Science at CMS. "Over 70 percent of the antibiotics available today to treat bacterial and fungal infections were derived from land-based organisms. Now we are turning to the sea to discover new kinds of chemistry with improved biological activity."

Research and development areas that the award will support include:

- Drug discovery to promote health and wellness
- Detection technologies for both human-induced pollutants and for marine biotoxins focusing on prevention, forecasting and event response
- Algae farming to further development of biofuels and mariculture

"This facility will help us aggressively develop the next generation of biotechnology platforms and technologies, all based on marine resources and all employing the same financial models that serve the larger biotechnology sector," Baden says.

The 69,000-square-foot MARBIONC facility will house 12 laboratories, three large incubator laboratories for cultured research materials as well as office and meeting spaces. ▪

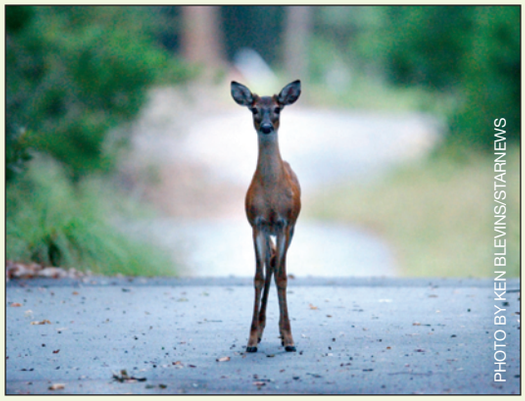


PHOTO BY KEN BLEVINS/STARNEWS

UNCW SCIENTISTS MONITOR BALD HEAD ISLAND DEER OVERPOPULATION

By Lindsay Key '11MFA

While assessing the impact of their increasing numbers, UNCW environmental scientists **Anthony Snider** and **John Taggart** also help to determine if white-tailed deer on Bald Head Island are restricted to the island. Hunting is not allowed, and the animals have no natural predators there.

Snider is studying the movement of the deer by tagging them with radio collars. If he finds that the deer are not intermingling with deer in the Smith Island marshes or at Fort Fisher, the conservancy may be able to inject the deer with an immunocontraceptive. But, if the population is open and injected deer could be hunted and eaten, the method will not be suitable. The drug has yet to be tested for its effect on humans. So far, monitoring efforts reveal no deer have moved outside the island.

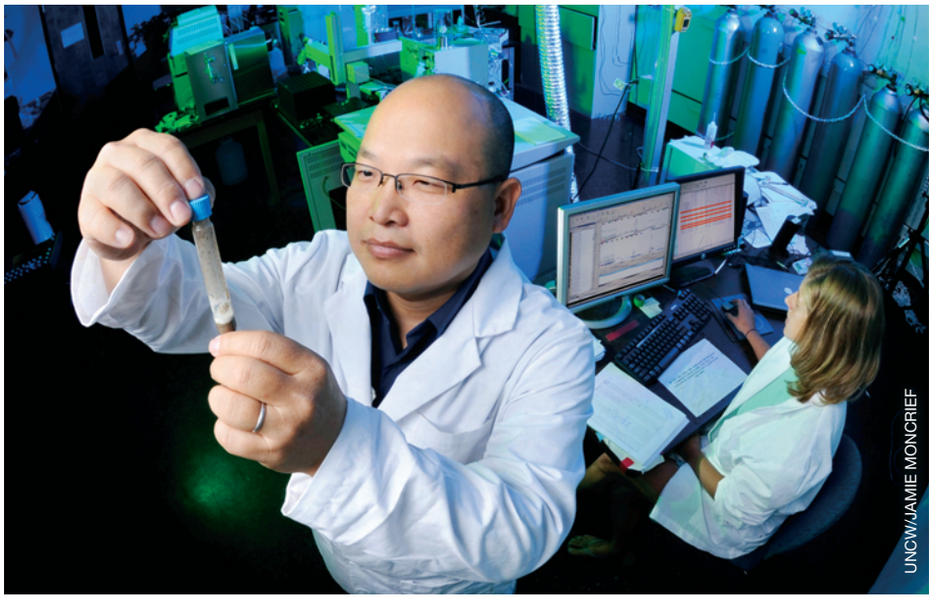
Taggart studies the effects of deer grazing habits on vegetation by placing 12 foot by 12 foot wooden fence enclosures around established live oak tree seedlings and saplings. Over the next two years, he will compare the health of the quarantined trees to those accessible to the deer.

According to Suzanne Dorsey, executive director of the Bald Head Island Conservancy, if the deer are overgrazing on the live oak tree population, they could alter the entire island's ecosystem. "It is a salt tolerant tree that serves to knit together the entire canopy in the forest. When hurricane force winds hit, the canopy shears the wind off, protecting the understory. Without this species we couldn't survive hurricanes nearly as well."

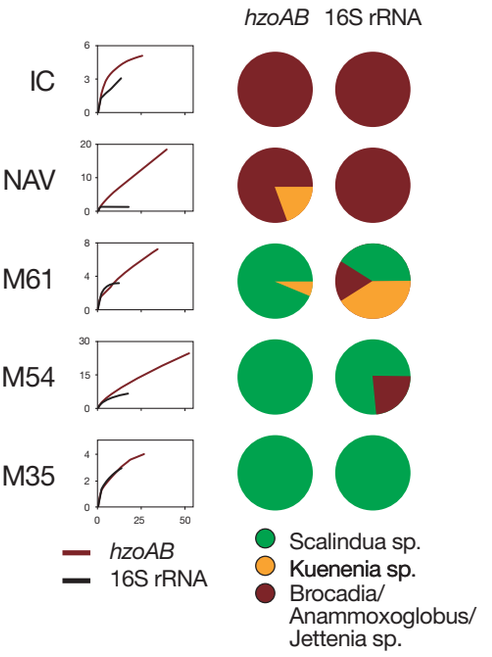
Dorsey says that most residents agree the population must be controlled, but are divided on whether to use lethal or non-lethal means. Currently, the village brings in sharp shooters each winter to reduce the population. ▪

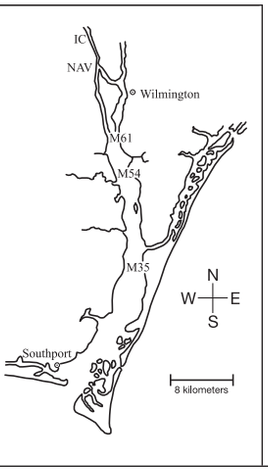
The Village of Bald Head Island funds this research through the Bald Head Island Conservancy.

ANAMMOX: A TWO-FRONT ATTACK ON NITROGEN CYCLE IMBALANCE



Professor **B.K. Song** has been awarded a total of $1,079,848 from the NSF, USDA, NC Pork Council and NC Sea Grant to study the dynamics of annamox microbial communities functioning within the carbon and nitrogen cycles of both marine and soil environments.





The map (left) outlines the Cape Fear Estuary and the locations of five water-sampling stations. The pie charts (above) show the population structure of anammox bacteria based on sequence data of *hzo* and 16S rRNA genes. The charts (left, above) show rarefaction curves of the sequence data depicted in the pie charts.

Bongkeun Song, assistant professor of biology and marine biology administration, has received two federal grants: one from the National Science Foundation (NSF) to study the importance of anaerobic ammonium oxidization (anammox) in the aquatic nitrogen cycle of the Cape Fear River Estuary and one from U.S. Department of Agriculture (USDA) to study this novel bacterial process in agricultural soils.

With the NSF award, funded at $515,800 for 2009-12 under the American Recovery and Reinvestment Act of 2009, the federal stimulus bill, Song will investigate the functional character of anammox bacteria in both the promotion of nitrogen removal and a healthy estuarine nitrogen cycle in the Cape Fear River.

With previous support from North Carolina Sea Grant, the research team headed by Song uncovered five different populations of anammox bacteria in the river. Typically, a single body of water has only one anammox population. The anomaly makes the Cape Fear a unique "anammox sanctuary."

The team also found that as the river transitions from a freshwater environment to brackish and then to saltwater, different anammox populations appear to dominate at different locations. The NSF grant will support research to understand the process driving anammox bacteria diversity as well as the linkage between community structure and function in the Cape Fear River Estuary. Until very recently, research on anammox bacteria focused for the most part on aquatic environments – and also on wastewater systems, where the anammox process was first uncovered.

The USDA grant, funded for 2009-12 at $397,048 by the Soil Process Program, will support an extensive examination of the nitrogen removal performance of the bacteria in agricultural soils, a new frontier of anammox research. Song and his team will focus on sites in the agricultural fields of North Carolina and expand to some states in the Midwest.

While less is known about potential importance of anammox in the soil nitrogen cycle, we do know that nitrogen plays an important role in productivity of plants – and that a lack of nitrogen in soils often limits yield. Presently, farmers put nitrogen into the soil using a combination of man-made industrial fertilizers and animal waste that is often in excess of what plants require, subsequently leaking out as a pollutant into aquifers and streams where the run-off harms marine life and disturbs the ecosystem. Additionally, the subsurface drainage and leaching further disturbs and depletes the soil nitrogen cycle as the nitrogen is prevented from completing its normal cyclical pattern of return to the atmosphere.

What scientists at UNCW hope to discover is a new job for these amazing bacteria as "anammox reactors," a role that could help to regulate the nitrogen cycle on both ecological fronts: the terrestrial and the aquatic. ▪

— William Davis '08 contributed to this article.

This material is based upon work supported by the National Science Foundation under grant number 0851435. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

A MARKET FOR ROTIFERS

By William Davis '08M

At UNCW's Center for Marine Science (CMS) Wrightsville Beach facility, researchers are exploring the commercial potential of the rotifer, a marine microorganism that is an essential food source for fresh and saltwater fish larvae, shrimp and crab larvae as well as live corals. For years, CMS staff has cultivated rotifers for university research. Now, they are using that expertise to develop new methods of breeding and shipping the organism for targeted markets.

Researchers culture B*rachionus rotundiformis*, which range in size from 90-150 µm and are smaller than other marketed species of rotifer. Since many marine fish will eat only live feed and only eat the smaller rotifers, "a lot of people consider them to be the backbone of the hatchery," says CMS research associate **Christopher Bentley**.

Currently, hatcheries must cultivate their own rotifers, a costly labor-intensive process.

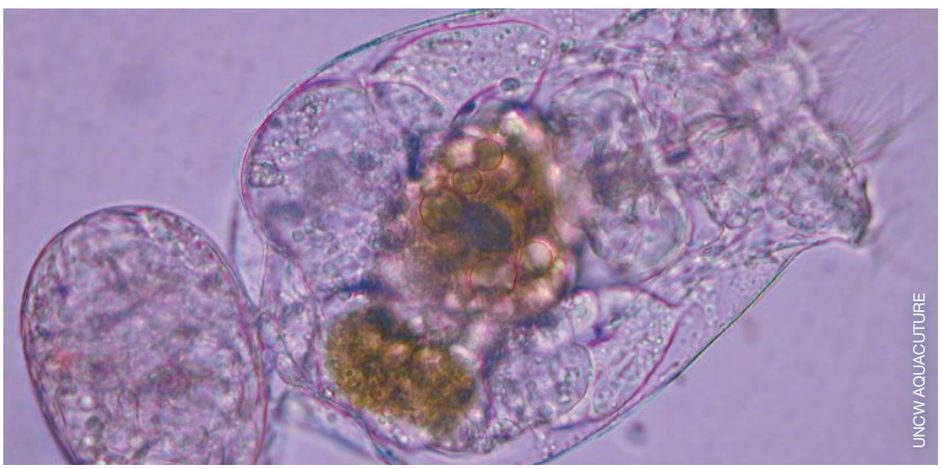
So, Bentley developed a method for cold-banking live small rotifers for safe, easy shipment. The process lowers the temperature of the culture, allowing the organism to survive shipment without daily feeding. Bentley says he recently shipped 20 million cold-banked rotifers to the University of Utah's zebrafish laboratory and successfully sent shipments to other facilities across the country as well.

The holy grail of the industry is finding a way to package and ship rotifers on a large scale, but significant barriers remain to its achievement. Even with cold banking, shipments still must be sent overnight. And for large hatcheries, "right now, it is more cost effective to culture it on your own," says Bentley.

Bentley looks to the recent invention of "instant algae" techniques by the Japanese as an example of what could be accomplished with rotifers. Like rotifers, algae was once cultured live on-site. Then, Japanese researchers developed a way to bottle an inert algae culture. Using the process, manufacturers developed low-cost algae that can be mass-produced, shipped worldwide at room temperature and refrigerated for months.

Bentley sees the potential for a similar breakthrough happening with rotifers at the Wrightsville Beach facility. "I think it's right on the verge," he says. ▪

Note: Rotifer researchers at CMS also assist private industry in the discovery of best practices for rotifer farming. Working with Aquatic Eco-Systems, a company that supplies equipment and consultation to the aquarium and hatchery industry, Bentley and others test their products. Recently, they developed a set of protocols for use of Aquatic Eco-Systems' high-density rotifer systems that the company has in turn sold to clients in the United States, Europe and Asia. UNCW researchers are also investigating bioencapsulation, a process that can increase rotifer growth rate by selective feeding. Using this process, it is possible to tailor various cultures of rotifers to fit the nutritional needs of different stocks of fish.



UNCW AQUACUTURE

UNCW/JAMIE MONCRIEF

QENO
Quality Enhancement for Nonprofit Organizations

By Lindsay Key MFA '11

Don Skinner, executive director of the local nonprofit Phoenix Employment Ministries, believes efficiency is everything when running a 501c3 organization with limited funding and staffing. Skinner's agency empowers homeless people with the skills and self-confidence they need to find satisfying work.

Skinner's agency is one of more than 2,000 501c3 nonprofit organizations in southeastern North Carolina. Their missions vary – from providing shelter and food to helping ex-offenders find jobs to facilitating afterschool opportunities for children and advancing art appreciation.

Until recently, these nonprofits had no comprehensive resource in the area to assist with organizational development. Now nonprofit directors and their boards – who serve others' needs so well – can receive training in best management practices to answer *their* needs.

In 2006, with the support of local funders, community leaders and UNCW faculty and administrators, Quality Enhancement for Nonprofit Organizations (QENO) was initiated to build the capacity of nonprofit organizations and increase philanthropy in southeastern North Carolina. An early contribution was a needs assessment made by UNCW Master of Public Administration (MPA) students from the Department of Public and International

Affairs that identified the services nonprofits in New Hanover, Pender and Brunswick counties required. A QENO advisory committee used the report to design action plans that focused on board training, recruitment of employees and volunteers as well as building effective communication within the agencies and with the public.

With the leadership of MPA professors **Steve Meinhold**, **Laurie Paarlberg** and **Tom Barth** and with strong institutional support from UNCW's Office of Academic Affairs and Division for Public Service and Continuing Studies, QENO has matured into a program that is truly advancing the nonprofit sector in our region.

On July 1, 2009, **Karen Pappas** (photo left) became the new director of QENO. With experience in human relations, communications and fundraising, Pappas is prepared to help nonprofits reach their goals and objectives. Currently, she facilitates a peer-led Executive Director Roundtable that brings directors together to share their problems and successes and a new program that connects boards with expert volunteer advisors.

For Skinner, the strategies and consulting services for staff development really have helped. "Recently I attended a seminar where we were taught to write 'results descriptions' rather than 'job descriptions,'" Skinner says. "The staff and I did this together. We have changed job titles and nailed down exactly the results each staff person is responsible for."

Skinner and his board worked one-on-one with QENO-contracted consultant Keri Erb, who provided advice on their decision to purchase a building and suggested the use of consent agendas, which bundle routine items for vote and streamline meetings. "It allows us to spend our time looking at our goals," Skinner says.

"Nonprofits operate in increasingly complex environments balancing needs of multiple stakeholders with often competing demands," Paarlberg says. "As a result, nonprofit leaders need to possess increasingly professional management skills. These supportive services are designed to help them succeed." ▪

Note: Primary funders include the City of Wilmington, The Kate B. Reynolds Foundation, Cape Fear Memorial Foundation, United Way of the Cape Fear Area, The Landfall Foundation and Community Foundation of Southeastern N.C. A 23-member QENO advisory committee includes experienced representatives from government, nonprofit and business sectors who can provide support and feedback as well.

GRADUATE STUDENT PROFILE

Paleontologist and Ph.D. candidate **Christy Visaggi's** doctoral research is currently supported by the National Geographic Society, Sigma Xi, Conchologists of America, the Houston Conchology Society (Constance E. Boone Award), the Southeastern Section of the Geological Society of America, UNCW's Brauer Fellowships and the Office of International Programs.

Visaggi has published in the *Journal of Vertebrate Paleontology* and *Science* magazine and the National Park Service's *Natural Resource Report*. Her scholarly activity includes presentations before the Geological Society of America Annual Meeting, Geological Society of America Southeastern Section Meeting, North American Paleontological Convention and the American Malacological Society Meeting. She has co-authored more than 25 abstracts.

Her teaching and lab instruction in both the geography and geology and marine biology programs has led to two teaching awards and a Distinguished Service Award. Visaggi has served the Evolution Learning Community as a coordinator and administrative assistant since its inception, co-organizing the successful ELC Student Conference, which attracted undergraduate student presenters from throughout the nation and as far away as Australia. She is also a facilitator and mentor in the "Research Experiences for Undergraduates (REU) in Biodiversity Conservation" program. *(See related story on page 19.)* Currently she serves as a student representative for the Paleontological Society in charge of developing the student section of the Web site. ▪

DISTINGUISHED UNDERGRADUATES

Students Brandon Hilton '11 *(left)* and **Phillip Whisenhunt '10** *(right)* were selected as the first Science and Technology Scholars for the Intelligence Community (IC) Center of Academic Excellence (CAE) Scholars Program sponsored by the Office of the Director of National Intelligence (ODNI). On July 28-30, 2009, they traveled to Washington, D.C., to join other IC scholars at a summer workshop that introduced them to the mission of the intelligence community.

While in Washington, they met with U.S. Congressman Mike McIntyre and several top administrators from the Central Intelligence Agency and the Department of Homeland Security. Both students work in the area of biometrics with UNCW's Face Aging Group. *(See related story on page 19.)*

Information Technology is one of five critical fields identified by the IC CAE Program for advancement in order to address current national security challenges and needs. ▪

STUDENTS LEAD IN HIGH TECH

By William Davis '08M

"I have never, in the six years I've taught, had students run to me to show me what they had done." – Christopher Gordon

Christopher Gordon, science teacher at West Pender Middle School

Last year, West Pender eighth-grader **Mike Frailey** began using Squeak, a computer programming language that has been used to help teachers of grades 7-12 teach science, technology, engineering and math (STEM) through technology. Since learning Squeak, Frailey has independently created more than 50 Squeak STEM projects. His creations range from games that determine whether a user has entered the correct answer to a set of math questions to creating an interactive world map that models continental drift.

Science teacher Christopher Gordon points to Frailey as an example of a student who has benefited from participation in the project, Using Squeak to Infuse Information Technology (USeIT), a collaboration between UNC Wilmington's Watson School of Education and the UNCW Department of Computer Science.

USeIT encourages young students in New Hanover, Pender and Brunswick County school districts to learn computer programming in a way that enhances their knowledge of the STEM curriculum – with the hope that students may choose IT fields and careers.

Frailey, who never programmed a computer before learning Squeak, now uses it independently for class projects and is teaching himself Java Script programming language. "This is what I want to do when I grow up," he says.

Gordon's science class at West Pender Middle School in rural Burgaw has spent the last two years creating experiments and building presentations using Squeak. Gordon says Squeak allows him to create hands-on experiences for his students that deepen their understanding of science material in a way that is difficult to emulate in a standard lecture format.

The versatility of the Squeak software package permits teachers and students to customize the technology for applications in every part of the curriculum. It gives teachers in STEM-related fields the tools they

need to virtually model STEM experiments and provide immediate student feedback.

For Gordon, an amazing benefit of the program has been the student-initiated learning. Gordon says, once students master the basics of the program, they not only can work independently but also assist each other, "By the time they get in the eighth grade, they know how to use it better than I can."

A $1.2 million National Science Foundation grant – designed to help local schools fight the national decline in student performance in STEM disciplines – funds the three-year project. Estimates are that USeIT will directly engage 75 STEM teachers and 150 students in the tri-county region by the middle of 2010. Indirect grant-related activities are projected to benefit more than 1,000 students. UNCW team members include project director and professor of computer science **Gene Tagliarini**, assistant professor of education at Watson School of Education **Shelby Morge** and professor and computer science department chair **Sridhar Narayan**.

According to Morge, when K-12 students are presented with new technology, they tend to adapt quicker than some of their teachers, a reversal of the usual teaching situation. Teacher assistance is built into the program. Each summer, workshops familiarize teachers with the software, and teachers can receive follow-up training throughout the school year. Because teachers are held responsible for teaching the standard course of study and their students are assessed on those standards, special professional development sessions emphasize ways for them to incorporate Squeak in their standard lesson plans, Morge says.

Gordon and other teachers are out front in modeling the effort. This afternoon, in Gordon's seventh grade classroom, more than 30 students sit focused on their black "netbooks." They just completed end-of-grade testing assessments in the morning, yet are excited about their computer programming assignment on food chain activities.

Student **Carmen Springfield**, one of the strongest programmers in the class, demonstrates the day's assignment – programming a model of a North Carolina forest's food web. Using pictures, sounds and animations to trace the ecosystem's chain of life from microorganisms to apex predators, she programs an interactive presentation drawn from her own research.

Springfield says that she had never programmed a computer before coming to Gordon's class, but is now able to research, design and implement a program in a single class period – saying proudly, "If you just put your mind to it, it should take about 45 minutes."

Learning Squeak is Easy and Fun

Squeak uses menus and drag-and-drop elements to build programs instead of typed code. With only two or three hours of training, students are able to begin to design interactive elements like quizzes and puzzles and create programs that feature moving animation and sounds.

—

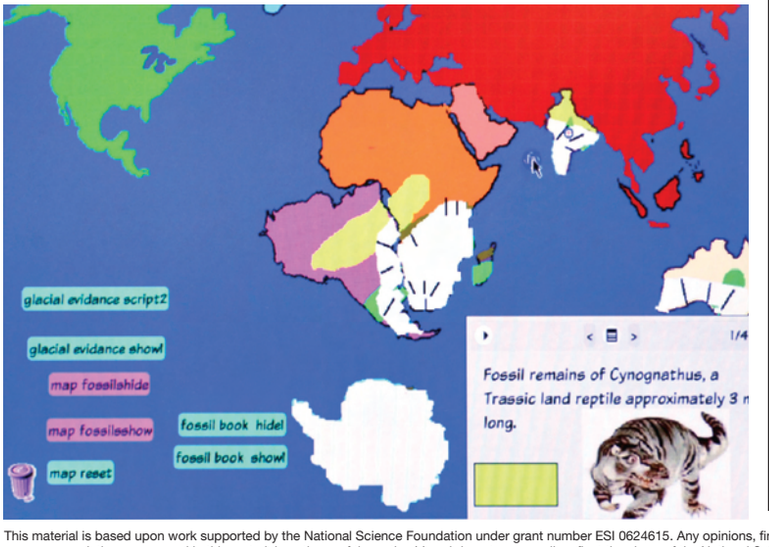
The use of Squeak as an educational tool builds on more than 40 years of research on the use of computers in classroom environments. In 1968, University of Utah researcher Alan Kay developed the idea of the Dynabook, a networked touch-screen computer designed for the classroom. Kay pitched his idea to Xerox PARC, a research and development company in Palo Alto, Calif. with a distinguished reputation in the field of computing. The result was Smalltalk, an easy-to-use programming language that allows students and teachers to build their own programs. Squeak, a direct descendent of the project, uses the Smalltalk language.

Kay's work drew heavily on Swiss philosopher Jean Piaget's constructivist theory of knowing. A central element of this theory is that students learn by making and doing.

Student Carmen Springfield had never programmed a computer before; now she is one of the best programmers in the class.

A model of engagement and collaborative learning, these West Pender Middle School students prove the value of Squeak as an effective teaching tool.

West Pender Middle School's successful use of this cutting-edge program puts the school in very good company. Immersing students in science, technology, engineering and mathematics by encouraging natural problem solving in organic ways is how we learn our native language. At West Pender Middle School, it's definitely working. ▪



Mike Frailey (photo upper left) designed this program so that by clicking on any landmass, users can pull up its fossil record, an aid to indentifying stages of continental drift and separation.

This material is based upon work supported by the National Science Foundation under grant number ESI 0624615. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

REU YEAR TWO: SUMMER SCHOLARS

By Kim Proukou '06M

UNCW's Research Experience for Undergraduates equips students for graduate study and careers, encouraging them to continue in the field of biodiversity conservation and share their knowledge with others.

Steve Durham, REU '08 of Dartmouth and **Andrew Tran**, REU '09 of Virginia Tech study predation preferences of snails in the Running Seawater Facility at the Center for Marine Science (CMS). Durham returned to UNCW on his own to prepare his research for publication. "Not many undergraduates have this opportunity – to carry your research through presentation all the way to publication," he says. Tran learned how to set up his experiments from Durham's experience. REU undergraduate colleagues work collaboratively with each other and with faculty and graduate student mentors in laboratories on campus, at CMS and at a dozen or more field sites.

Right after graduation, as the summer heat advances, a new intellectual intensity asserts itself: a brand of learning so compelling that the brightest young scholars in the nation mark UNC Wilmington their target destination for advanced undergraduate summer research.

UNCW Professor of Geology **Patricia Kelley** and Gregory Dietl, director of collections at the Paleontological Research Institution in Ithaca, N.Y., have designed a program, "Research Experiences for Undergraduates (REU) in Biodiversity Conservation," that allows select undergraduates from across the nation to discover what conducting research is really like.

With support from the National Science Foundation (NSF), these rising juniors and seniors compare fossil, archeological and modern marine samples to understand how the Southeastern coastal marine ecosystem has changed through time and how human activity and behavior has affected that change. Based on program outcomes, NSF support is renewed annually for up to three years.

In 2009, nine undergraduate students were accepted from 150 applicants to make up the cohort for REU Year Two. They came from institutions as far away as Seattle University, the University of Puerto Rico, Oberlin College, Cornell and Mississippi State – and as near as Chapel Hill.

For eight weeks, the REU takes over the first floor of DeLoach Hall. The Paleontology Laboratory is alive with students and their faculty and graduate student mentors studying fossil and modern samples. All undergraduate researchers are expected to present and publish the results of their investigations.

Students analyze shell records gleaned from ancient Native American shell middens and other sites and

compare them with modern censuses, synthesizing a wide variety of data from live mollusks as well as fossils.

"We are trying to understand how the marine ecosystem has changed over the past 3 million years," Kelley says. "By looking at the fossil and archeological records we can provide a baseline for comparison to the modern ecosystem. This helps us to understand extinction events – past and present – and to evaluate the health of current marine communities adversely affected by human activity in varying degrees."

The scars and borings of predators on clam and oyster shells preserve a near timeless record of mollusk predation pressures. This historical account is compared and contrasted with current information on the diversity, life roles and behaviors of modern mollusk species, making it possible for students to reconstruct changes in the marine ecosystem since the Pliocene Epoch several million years ago.

Dietl, a leading authority on trace fossil predation record, was once a student of Kelley's. His current research uses historical data from the geological and archeological past – its diversity, patterns, systems and processes – to help build sustainable modern communities. "It is important to disentangle natural effects from human interventions using the geo-historical record as well as experimental results," Dietl explains. "For example, without the historical data, we would have no clue what these ecosystems looked like long ago; because a million years ago, there was no-long term scientific monitoring. The stressors we study in the Pliocene Extinction are very similar to those being experienced today."

Visiting the lab in DeLoach Hall 105 on a sweltering July afternoon, I find REU students peering through microscopes, while others hover over wet newspapers on which fossil shells, just washed from their sediment matrix, are laid out to dry. Students sort through shell samples, noting shells that bear attack scars from predators: a fossil record of constant stress.

Faculty and graduate student mentors move in and out of the lab as spontaneous conferences arise and research results are discussed. This afternoon, discussions focus on distinguishing human interventions from natural effects of environmental change.

As I listen, I notice carefully marked bags of sediment arranged in the corner of the south wall of the lab and kneel down to read the labels.

The bags are fossil-rich sediment samples from several sites in southeastern North Carolina: near James City on the Neuse River, Colerain Beach on the Chowan River, and of course Natural Well near Magnolia – a rich depository. Many specimens from Natural Well are preserved in museums throughout the country.

Looking for microfossils with the aid of microscopes, students pick through grains of sediment. Cecilia Borges from Seattle University explains that fossils of these single-celled microscopic organisms can be used to determine the age of the sediment.

Later, Dietl will teach me "to also consider what is missing in an ecosystem. Green turtles have almost vanished in the Caribbean, and off the North Carolina coast, loggerhead turtles are nearly gone," he says. "How are these systems different now without them?" I learn that from the record of succession of one type of organism replacing another within an ecosystem, it is possible to deduce the amount and nature of change impacting the system.

From the research and publications that these REU undergraduates and their mentors are producing, we will come to understand how the coast of southeastern North Carolina has changed through time – from the Pliocene Epoch to the 21st century. We will learn to better diagnose and manage the health of today's fragile, coastal ecosystems. Their investigations may also suggest practical ways to better design a reserve or what measures need to be taken, and when, to prevent extinction events – that's quite a course of summer learning. ▪

Above: Cecilia Borges Farfan of Seattle University and **John Tenney** of Mississippi State University extract microfossils specimens from sediment samples.

BOOKS, CD RACKS AND FILMS

Celebrate Piano!®
by Cathy Albergo, *music department chair,*
J. Mitzi Kolar and Mark Mrozinski

Lead author Cathy Albergo and co-authors set young piano students on the path to musicianship with comprehensive piano method that is innovative and engaging. *Celebrate Piano!®* develops reading and playing skills by giving young learners music they want to play. Each unit includes activities in five areas: ear skills, rhythm skills, musicianship, creative activities and finger gymnastics.

"I love these materials. I appreciate the layout, the progression of information and skills acquired."

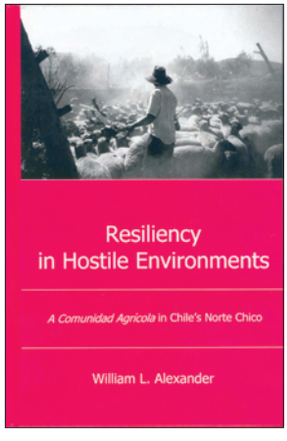
– Rachael Short, professor of piano pedagogy, Vanderbilt University

Celebration Series Perspectives: Handbook for Teachers
by Cathy Albergo, Reid Alexander and Marvin Blickenstaff
(Frederick Harris Music Co. Ltd. Fourth Edition 2009)

This comprehensive teaching aid collates the Celebration Series, Piano Repertoire and Piano Studies/Etudes books, student workbooks and recordings for optimum use in the teaching studio.

"A resource that no piano teacher should be without!"

— David Sharpe, senior examiner, American National Music Certificate Program and the Canadian Royal Conservatory of Music Examinations

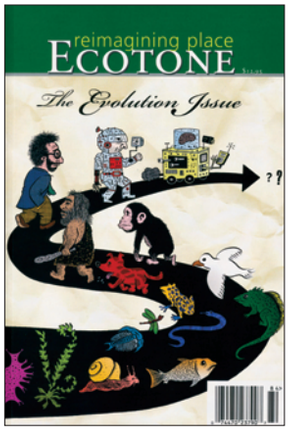


Resiliency in Hostile Environments: A *Communidad Agricola* in Chile's Norte Chico
by William L. Alexander,
assistant professor of anthropology
(Lehigh University Press, 2008)

Compiled from three years of fieldwork, William Alexander's book is the first published ethnography of communero culture in the Coquimbo region of Chile. Researchers and students will benefit from Alexander's scholarship. General readers will be engaged by the stories of these inspirational people. In a harsh climate, in changing times, the comunidades agrícoloas of Norte Chile not only survive with very few resources, but occasionally thrive by valuing both individual advancement and communal solidarity.

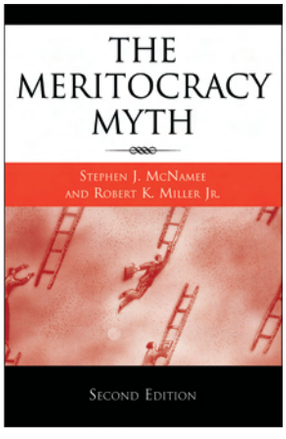
"...a complete and lively picture of the community."

— Gloria L. Gallardo Fernández
Uppsala University



Ecotone
David Gessner, Editor
associate professor
Ben George, Managing Editor,
Compiler, *lecturer*
Emily Smith, Art Director
lecturer creative writing

The Evolution Issue of the national journal *Ecotone* was listed as a "Notable Special Issue," in *Best American Essays 2009. The Evolution Issue* was also nominated for the Utne Independent Press Award for Environmental Coverage (2009). Managing editor Ben George notes that "in the past three years, only three magazines in the entire country have had their work reprinted in *Best American Short Stories*, *Best American Poetry* and *Best American Science and Nature Writing*. They are *The New Yorker*, *The Atlantic Monthly* and *Ecotone*." Salman Rushdie, in his introduction to *Best American Short Stories 2008*, named *Ecotone* one of 10 literary journals on which "the health of the American short story depends."



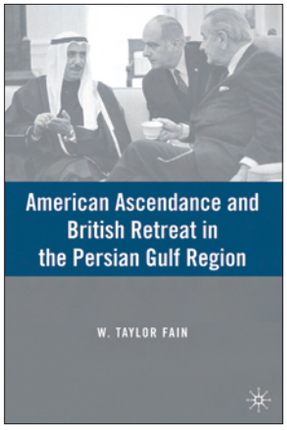
The Meritocracy Myth, 2nd Edition
by Stephen J. McNamee and
Robert K. Miller Jr.,
professors of sociology
(Scarecrow Press Inc., 2009)

"Every decade or so, a book comes along that seems to capture the sociological sense of American Society on some important issues."

— Ronald C. Wimberley
North Carolina State University

According to the American Dream, individuals can go as far as their merit takes them. "In our book we challenge that," Stephan McNamee and Robert Miller say, arguing that there is a gap between how people think the system works and how it really works. They call this gap 'the meritocracy myth.'

Balancing the usual arguments of fate, fortune and fortitude with realism, McNamee and Miller say, "We may always have the rich and poor among us, but we need neither exalt the former nor condemn the latter."

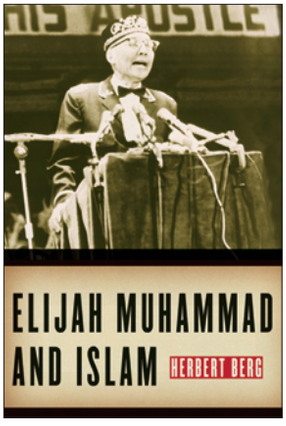


American Ascendance and British Retreat in the Persian Gulf Region
by W. Taylor Fain,
assistant professor of history
(Palgrave McMillian, 2008)

"… a significant contribution to our understanding of Anglo-American relations in the Persian Gulf, (Fain's) work will probably be mandatory reading for all scholars in this field."

— The American Historical Review

In a well-written, well-researched comprehensive account, Taylor Fain critically examines U.S. failure to contend with the legacy and lessons of British dominance. This failure to discern the differences, similarities and exact identities of British and American interests was a mistake that helped to bring about American embroilment in the Gulf, the Arabian Peninsula – and Iraq.



Elijah Muhammad and Islam
by Herbert Berg,
professor of philosophy and religion, director of graduate liberal studies
(New York University Press, 2009)

Herbert Berg investigates Elijah Muhammad within the larger Islamic tradition, exploring his faith journey, interpretation of Islam and use of the Qur'an – as well as Elijah Muhammad's relationships with his mentors in the faith and with other Muslims.

With exceptional intellectual integrity, Berg consistently seeks to understand – not define or label – the man and his choices. The story helps to make sense of a complex figure, strongly affected by adversity, whose need to make account for suffering and contend with anger fostered unusual connections.

MULTI-MEDIA

Winner of the 2009
University Film & Video Association's
"Fiction Juried Screening Award."

Two Hours in the Dark
written, directed and produced by Chip Hackler, *assistant professor film studies*
www.TwoHoursInTheDark.org

Two Hours in the Dark is a collaboration of UNCW film studies faculty, student interns and Wilmington filmmaking professionals, including the Emmy Award-winning Fincannon Casting agency. The late Frank Capra Jr., former UNCW Distinguished Visiting Professor in film studies and past-president of EUE Screen Gems Studios, served as advisor.

Creative work presents serious interior challenges to creative people, including what Eric Maisel calls "The Van Gough Blues." After the 1934 film *It Happened One Night* won five Oscars, darkness overcame director Frank Capra. Becoming convinced his next film would fail, Capra was deteriorating physically and emotionally – until a mysterious stranger came to call – changing his life and the film industry, forever.

The Wounded Come Home: Hope for the Warriors
directed by Lou Buttino, *film studies chair*;
edited by Taylor Gill '09

New medical advances produce greater survival rates for injured soldiers returning from Afghanistan and Iraq; however, they also suffer some of the most vicious wounds. This television documentary series looks at their struggles and highlights the individuals and groups across America who are answering the call to help.

AUDIO

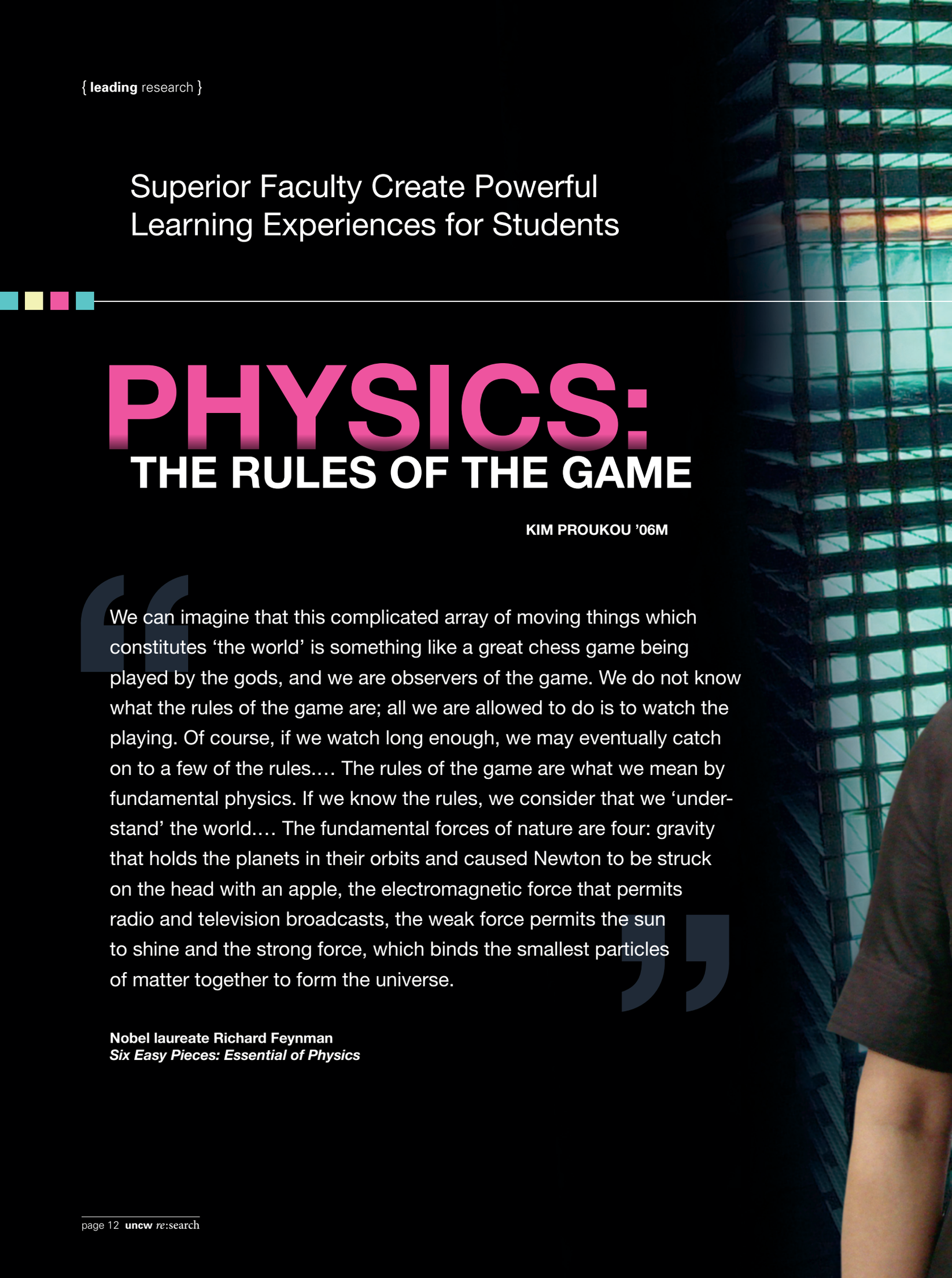
Flute, Naturally
Mary Jo White,
assistant professor of music
(Flutelris Classics, 2008)
www.uncw.edu/music

Works for a solo instrument without accompaniment provide new and rewarding opportunities for nuance, expressiveness and variety of sound. *Flute, Naturally* is a newly released CD of inspirations for solo flute performed by Mary Jo White that include the complete solo flute works of Benjamin Boone along with selections by Dahl, Koechlin, Hindemith, Debussy and Marais.

Superior Faculty Create Powerful Learning Experiences for Students

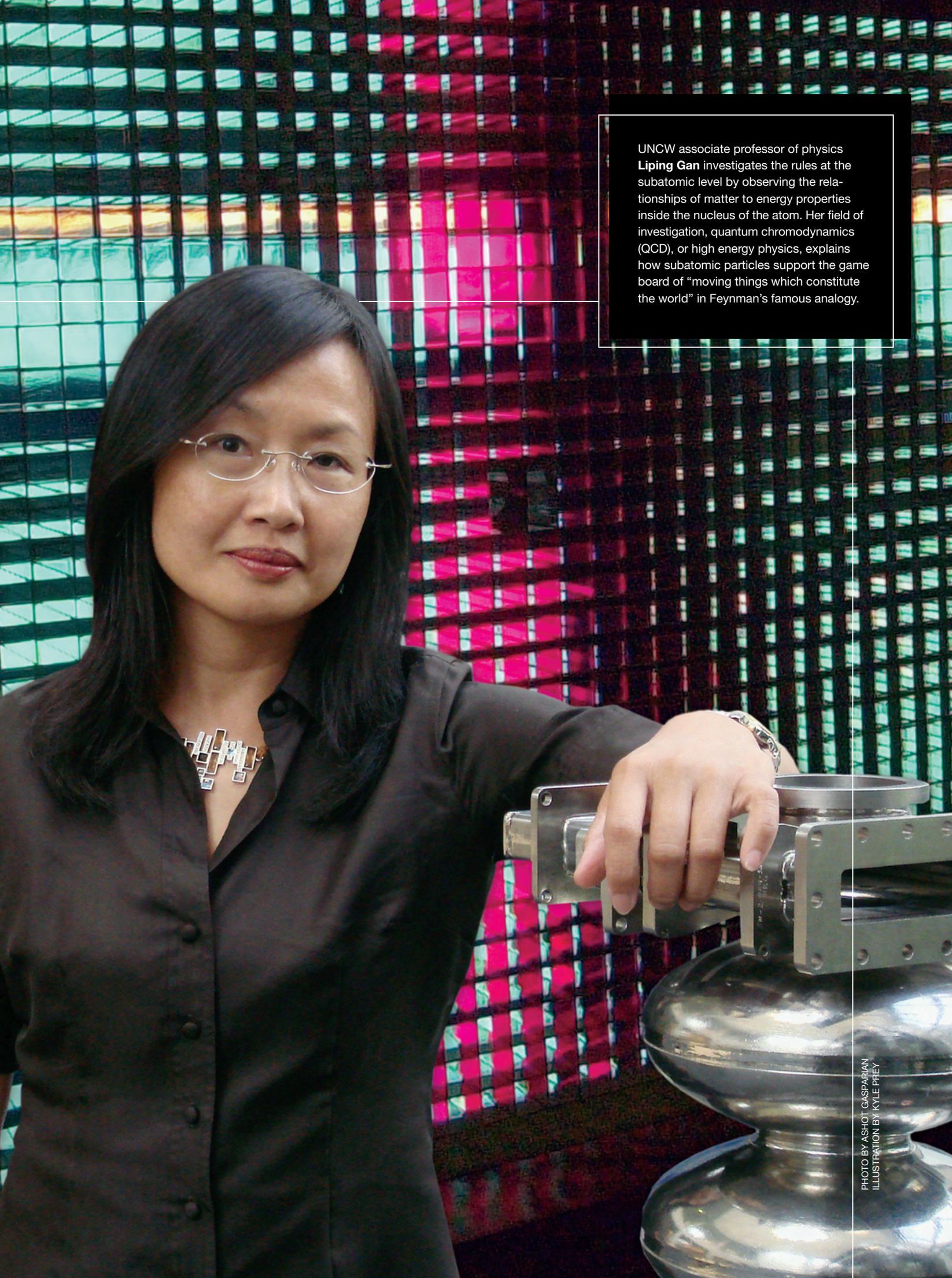
PHYSICS:
THE RULES OF THE GAME

KIM PROUKOU '06M



"We can imagine that this complicated array of moving things which constitutes 'the world' is something like a great chess game being played by the gods, and we are observers of the game. We do not know what the rules of the game are; all we are allowed to do is to watch the playing. Of course, if we watch long enough, we may eventually catch on to a few of the rules.… The rules of the game are what we mean by fundamental physics. If we know the rules, we consider that we 'understand' the world.… The fundamental forces of nature are four: gravity that holds the planets in their orbits and caused Newton to be struck on the head with an apple, the electromagnetic force that permits radio and television broadcasts, the weak force permits the sun to shine and the strong force, which binds the smallest particles of matter together to form the universe."

Nobel laureate Richard Feynman
Six Easy Pieces: Essential of Physics



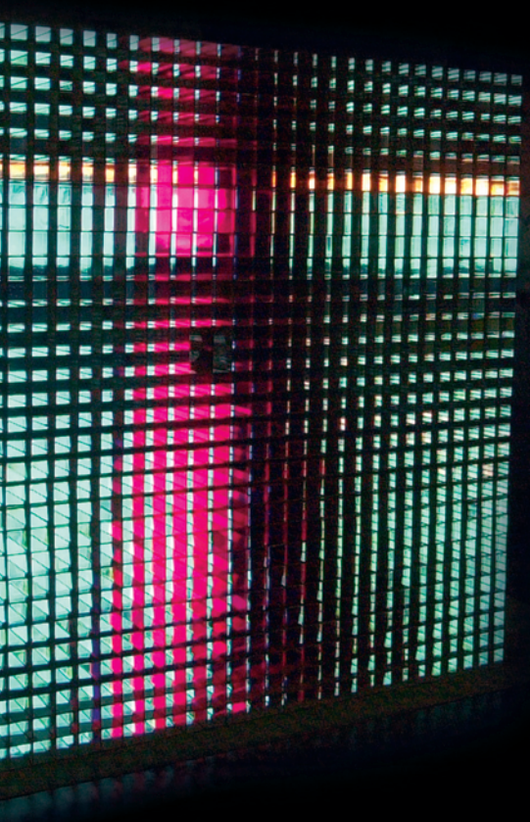
UNCW associate professor of physics **Liping Gan** investigates the rules at the subatomic level by observing the relationships of matter to energy properties inside the nucleus of the atom. Her field of investigation, quantum chromodynamics (QCD), or high energy physics, explains how subatomic particles support the game board of "moving things which constitute the world" in Feynman's famous analogy.

PHOTO BY ASHOT GASPARIAN
ILLUSTRATION BY KYLE PREY

The Rules

Of the four forces that cause a mass to accelerate – gravity, the electromagnetic force, the weak and strong force – only two, gravity and electromagnetism, are experienced in the macroscopic world, the familiar land of large objects that accelerate with predictable momentum.

In the subatomic world of microscopic things, the land of the small, momentum is far more random, discoveries more serendipitous. Understanding the forces at work within the interior of atoms has produced new advanced imaging for medical diagnosis and treatment (MRIs) and promises future benefits in the fields of quantum computing, nuclear technology, nanotechnology and electric transmission and distribution.



In seeking to understand the rules of the subatomic realm, Gan says, "we seek some of the most important questions in physics."

In the Big Bang that laid the foundation of the universe, an expansion of pure energy dispersed both matter and antimatter – a cascade into the opposites, a spontaneous breaking of symmetries that continued through space and time that accounts for the diversity of the universe or perhaps, even for multiple universes.

Gan's interest is the strong force that binds particles at the subatomic level – that permits more complex structures, atoms and molecules, to rise.

THE HUMBLE PION: LEAST OF ALL QUARKS

To better understand the rules governing the strong force, Gan studies the chargeless pion, least of all quark-mesons and the lightest of the quark-hadron particles.

In the quest for understanding the low-energy properties of the strong force, "It would be nice to directly study the quark, but, there is too much energy to study quarks. They are fierce," Gan says, tugging against the air with her fists and elbows to reinforce the principle. "Because of this property that won't allow separation, it is better to study the pion." Better, with one exception: the pion lifetime is about 10 to the minus 16th power of a second making direct observation of its properties almost impossible – until recently.

At the U.S. Dept. of Energy Office of Science physics laboratory at the Thomas Jefferson National Accelerator Facility (JLab) in Newport News, Va., Gan and a 70-member team of national and international physicists built an advanced high-resolution multi-channel calorimeter (HYCAL) to produce the most accurate account of pion lifetime to date. Gan, an experimental physicist, was a leader in the design and development of HYCAL and continues to lead in the development of experimental equipment and processes at JLab for the project.

Gan and her team members were able to establish a new, more accurate pion lifetime by applying the Primakoff Effect, which lent its name to the project, the Primakoff Experiment or PrimEx and to the team, the PrimEx Collaboration.

The results of PrimEx have provided not only the most accurate account of the lifetime of the neutral pion to date but are also yielding new information on the strong force and the rules of broken chiral symmetries.

In recognition of this achievement, Gan was invited to speak at the April 2008 meeting of the American Physical Society

The Thomas Jefferson National Accelerator Facility is funded by the U.S. Department of Energy's Office of Science with support from the City of Newport News and the Commonwealth of Virginia. As a user facility for scientists worldwide, it's primary mission is to conduct basic research of the atom's nucleus at the quark level.

as part of the session "Topics in Nuclear Physics" where she presented the experiment on pion lifetime measurement, its results and implications.

THE OPPORTUNITY OF A LIFETIME

In 2001, Gan and a group of physics faculty established an undergraduate nuclear research lab in the physics department at UNCW to augment instruction in theory and provide training in experimental physics. This applied learning experience grew to include the offering of an undergraduate scholarship for two or three students to work in nuclear and particle physics at the Jefferson Laboratory facility and most recently to work on the PrimEx project.

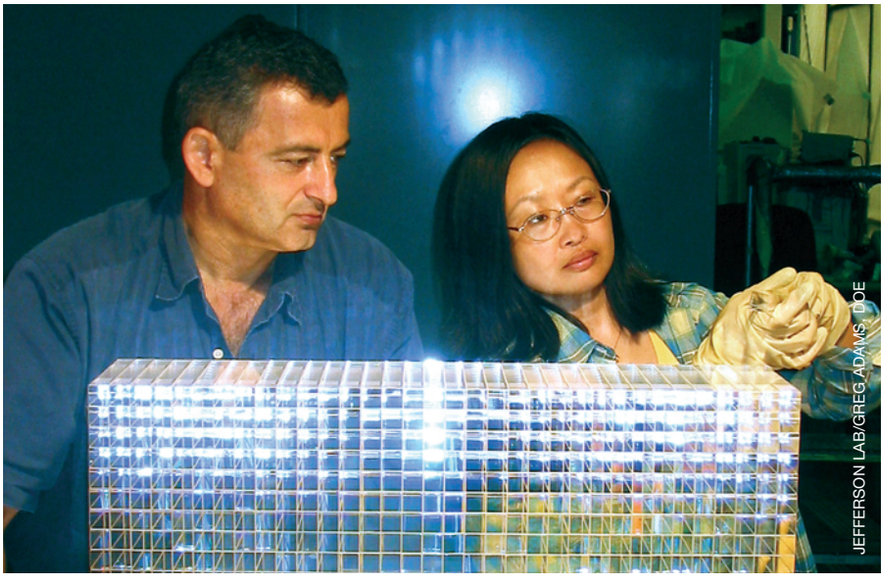
Since 2002, the National Science Foundation has been supporting the UNC Wilmington undergraduate physics research program by providing a $1500 per month stipend plus lodging during the summer for two or three undergraduates to participate in PrimEx. During the academic year, recipients are paid an hourly wage to continue their work. It is the opportunity of a lifetime.

Working for two months over the summer at JLab with world-renowned physicists and select national and international graduate students, these students learn to develop and maintain state-of-the-art high precision instruments and to work in the "counting house" collecting experimental data – learning and practicing skills invaluable to an experimental physicist.

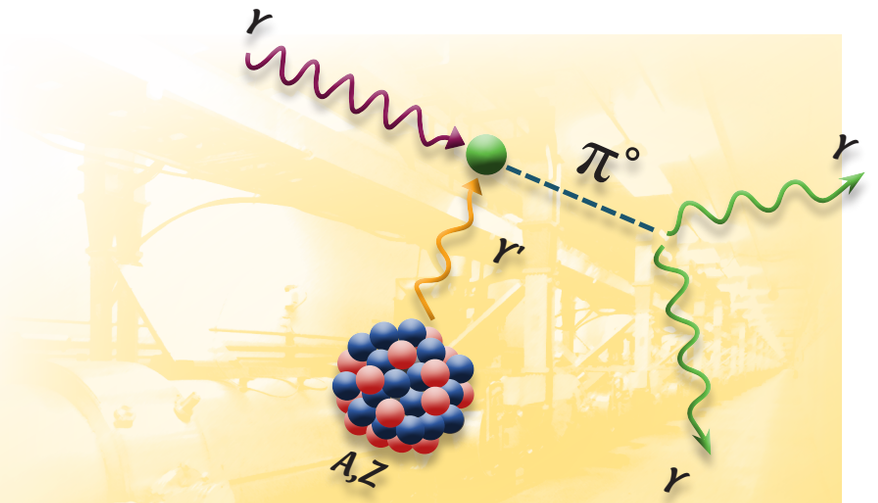
In June 2009, Erik Minges, senior, returned to JLab for his second summer, and Margaret Elizabeth Schneider, junior, joined the team for her first summer.

"Working at JLab has been life changing," Schneider says. "The people I have met here come from all over the world, all in the name of physics. Many of the participants in the PrimEx experiment are from Russia. My mentor is from France."

"My advice to anyone interested in working at JLab is: Go for it! It may appear intimidating, but in the end you will have learned more than you could imagine – more than any lecture can convey," Schneider says. "This experience has changed the way I look at the scientific world and research and increased my curiosity about nuclear physics."



Ashot Gasparian and UNCW associate professor of physics **Liping Gan** are two of five leaders of the 70-member international team, the PrimEx Collaboration, studying subatomic particles and quantum chromodynamics. Here, they work with HYCAL's bare lead tungstate scintillator crystals.



An Exceptional Experiment and Breakthrough

This particular experimental result – a new lifetime measurement of the neutral pion with the highest precision in the world – not only resolves much of the uncertainty of existing measurements of pion lifetime, but also confirms our present understanding of fundamental symmetries, chiral anomaly and chiral spontaneous symmetry breaking: those exceptions to determinant principles and forms in multiple, varied expressions that may explain the origins and dynamics of our diverse universe.

Because it is the simplest, strong interacting subatomic particle, the neutral pion provides the best test of Quantum Chromodynamics (QCD) at confinement scale. According to UNCW's Liping Gan, "The lifetime of the chargeless neutral pion is one of the few quantities that can be calculated precisely from QCD."

Quantum chromodynamics is a fundamental theory that describes the strong interaction: the force responsible for the activity and nature of the inner workings of the nucleus of the atom. In the nucleus of an atom, the protons and neutrons interact with each other by passing pions between themselves.

MY STUDENT EXPERIENCE

BY ERIK MINGES '10

In 2008, I was lucky enough to participate in my first summer internship with my nuclear physics professor Liping Gan working on the PrimEx experiment at Thomas Jefferson National Lab. The mission of the PrimEx collaboration is to measure the lifetime of the subatomic particle π^0, the neutral pion, with high precision. This experiment is a very important test of quantum chromodynamics – the theory to describe the strong interaction that holds quarks and gluons together to form protons, neutrons and other particles. The decay photons from the π^0s are detected by a high-resolution electromagnetic calorimeter (HYCAL) that consists of approximately 1200 channels of lead tungstate ($PbWO_4$) crystal and 600 channels of lead glass Cherenkov detectors. One of the big experimental challenges of the project was to understand the properties of this calorimeter, HYCAL. I was assigned to study HYCAL by analyzing data from a 6x6 $PbWO_4$ crystal prototype detector beam test.

This experience has taught me a tremendous amount about how to perform research. It has introduced me to many new, bright scientists and has opened doors to opportunities I could have only dreamed about!

In order to complete my data analysis of HYCAL, I had to determine crucial properties of the $PbWO_4$ crystals. Using a UNIX operating system, I was able to write programs in FORTRAN and C++ to perform a relative and global energy calibration and study the energy and position resolutions of the prototype detector.

I also studied the shower profile of the calorimeter, which measures the dependence of the average pulse-height ratio for different crystal channels. After writing more computer programs and performing tedious statistical analyses, I determined the adjacent channel, adjacent row and separated channel average pulse-height ratios. Amazingly, in my first summer at JLab, I had finished the energy calibration on the prototype and determined crucial properties of the $PbWO_4$ crystals!

I am excited that this program is available to students because it really provides an in-depth look at what a future career in science can be like. It has been amazing to use and learn so many advanced computer and engineering technologies and to work with top scientists in the world on cutting-edge nuclear research. This has been, by far, the most demanding – yet rewarding – experience I have yet to encounter in my life. ▪

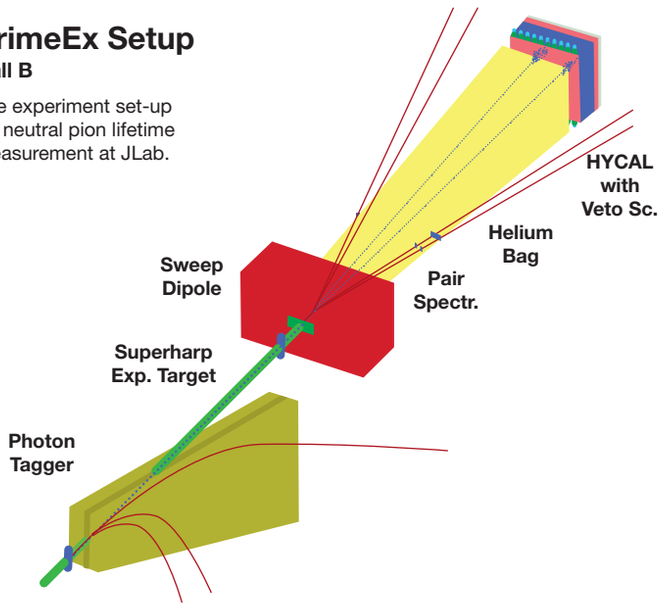
Internships at Jefferson Lab give students the opportunity to work on breakthrough research, a real-world research opportunity that promotes academic and career development.

Erik Minges '10 and
Margaret Elizabeth Schneider '11

PrimeEx Setup

Hall B

The experiment set-up for neutral pion lifetime measurement at JLab.



THE CURIOUS CASE OF BENJAMIN BUTTON IN PION LIFETIME

The PrimEx project uses the Primakoff effect as the theoretical basis for the design of pion lifetime experiments. While a pion may be short-lived, its decay into two photons is among one of the most accurate predictions in physics. Building on this prediction, physicist Henry Primakoff (1914-83) suggested that by beginning at the end of the pion lifespan, when a pion decays into two particles of light called photons, it could be possible to reverse time and create a pion from two photons.

Based on the theory, Gan and the PrimEx team aimed a gamma-ray beam at a nuclear target. With nuclei and their clouds of vibrating photons in sight, an incident photon successfully collided with a vibrating photon to form a new particle – rebirthing a pion. The newborn pion almost immediately decays into photons, which are detected by the HYCAL, a multi-channel lead crystal calorimeter detector which looks very much like a honeycomb.

By measuring the probability of the formation of pion from two-photon collisions, researchers were able to observe details of pion decay and secure a pion lifespan that is two-and-a-half times more accurate than the average of previous measurements. "Our result is the most precise measurement on the neutral pion lifetime in the world," Gan says. "Using the leading order-theory calculation, the pion lifespan is equal to 84 attoseconds."

Continued experiments have made it possible to further quantify pion transitions (aging) and to provide more detail of how subatomic actions bind quarks to make material structures.

BACK TO THE FUTURE

"These investigations will help us to understand many fundamental questions in nature," Gan says. "Where did the mass of matter come from? How are neutrons and protons bound in the nucleus? And, what was the role of breaking symmetries in the formation of the early universe?"

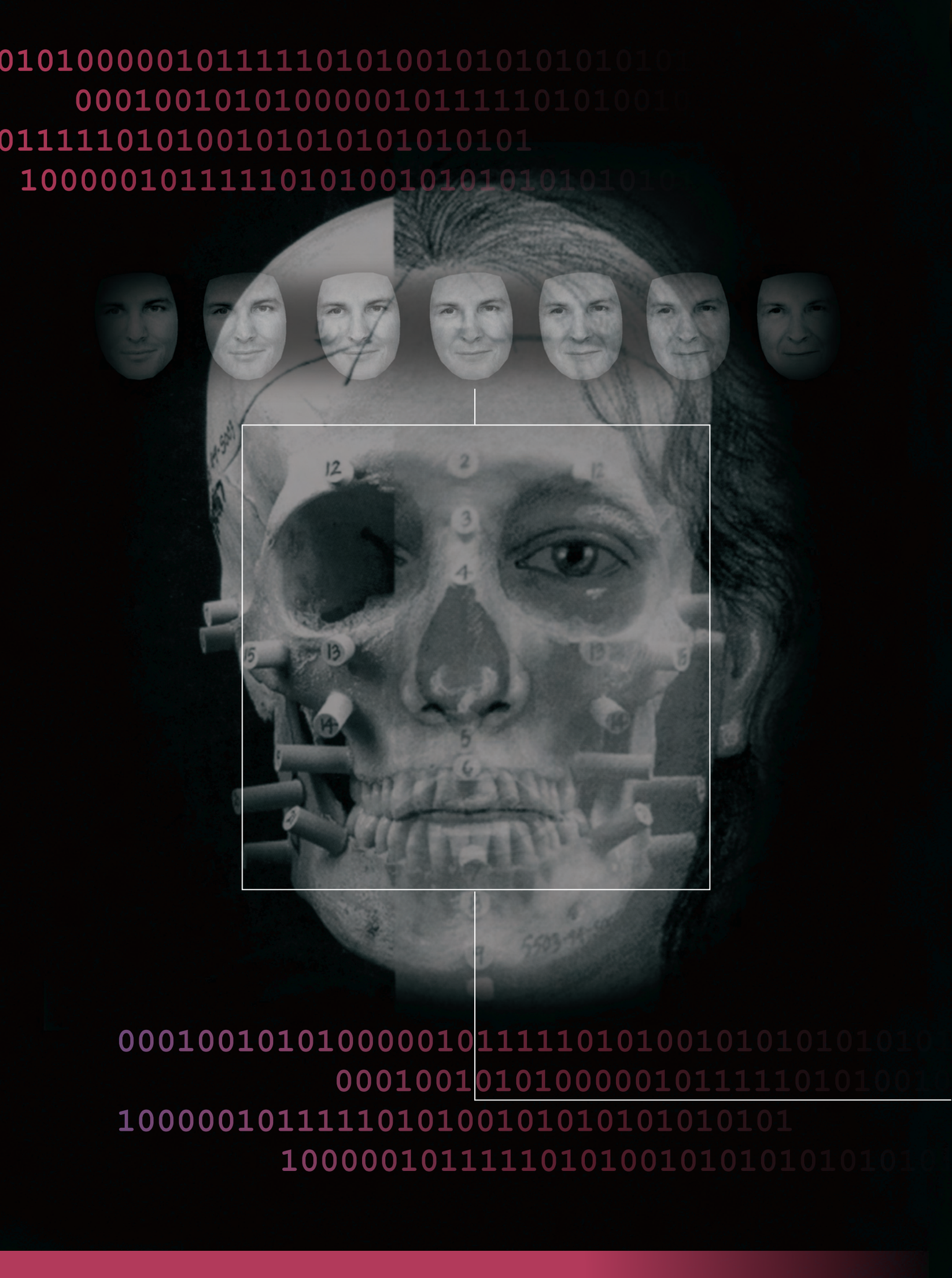
Gan's talent for combining undergraduate teaching with world-class research will ensure that UNCW students continue to play an integral role in the work of physicists on the second phase of the PrimEx result – predicted to improve the accuracy of pion lifetime measurement by five times the current value. ▪

"This research helps us understand many questions: where does the mass of the matter come from? How are quarks confined to form neutrons and protons? How was the earliest universe formed by breaking symmetries?"

– Liping Gan

APS physics

The Primakoff Experiment at Jefferson Lab, obtaining the most precise measurement of neutral pion lifetime to date, was announced in the June 2007 issue (Vol. 16, No. 6) of *American Physical News*. Full publication of the experiment is expected in 2010.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More *than just a face*

BY LINDSAY KEY '11MFA
AND KIM PROUKOU '06M

There are many technologies that fulfill the need for on-the-spot identification – like keyless entry, fingerprints or iris scan. But in traffic or a crowd, a fingerprint or an iris shape is difficult to spot. However, a face can be – as we say – "unforgettable," making composite facial recognition technology a highly sought-after identification solution in post 9-11 society.

Karl Ricanek (right), director of the Face Aging Group, is working with **Midori Albert** (center) and **Eric Patterson** (left) to solve the high error rates of national and international face recognition used in today's security screen processes.

UNCW/JAMIE MONCRIEF

In February 2009, the Office of the Director of National Intelligence (ODNI) designated UNCW as one of four universities to form a new Center for Academic Studies in Identity Sciences (CASIS), a **Center of Academic Excellence (CAE)**. CASIS is a pilot project that will furnish the intelligence community with research results in the field of biometrics for facial recognition imaging.

Karl Ricanek, Jr., associate professor of computer science and director of the Face Aging Group at UNC Wilmington, is an expert in face and age recognition. But even he couldn't predict how much UNCW's expertise in this area would grow in just five years.

The Face Aging Group at UNCW began as a shared interest between Ricanek and two other faculty members – forensic anthropologist **Midori Albert** and computer scientist **Eric Patterson**. The group was puzzled by the high error rates of national and international face recognition systems and decided to investigate ways to fuse the biomechanics of human facial aging with the power of algorithms.

Algorithms compute a sequence of qualifying queries – a technology solution for complex problems like face recognition that Ricanek had investigated for his doctoral thesis at North Carolina A&T State University.

By adding Albert's expertise in the identification of facial landmarks and Patterson's competence in computerized 3-D face modeling and computer graphics to Ricanek's algorithms, the group was able to create craniofacial morphological models from computer-generated algorithms that project and demonstrate how an individual captured in a 20-year-old photo might look today.

But the technology is also a challenge, because facial traits are difficult to project over time, and one can never have enough raw information to predict exactly how age or environment will change a person.

A New CAE

UNCW has been designated one of four universities forming a new Center of Academic Excellence (CAE). Ricanek and three other researchers, Marios Savvides from Carnegie Mellon University, Damon Woodard at Clemson University and Gerry

Previous page, L to R. Back row: Yishi Wang, assistant professor mathematics and statistics; Cuixian Chen, mathematics and statistics faculty; Amrutha Sethuram, research scholar; Midori Albert, associate professor anthropology; Karl Ricanek, Jr., associate professor computer science; Eric Patterson, associate professor computer science; Ricardo Valea '10. **Front Row:** Seiken Higashionna, graduate student; Brandon Hilton '11; Phillip Whisenhunt '10; Brian Bullard, graduate student; Fernando Schiefelbein, graduate student.

Dozier of North Carolina A&T University will direct the new collaborative CAE.

The new center's goal is to further research in the field of identity sciences by developing mathematical algorithms that will extend the capability of biometric identification. For UNCW that involves algorithms to generate synthetic representations of a person over the full range of adulthood. These algorithms will compute how a person's face might age in 10, 20 or 30 years – helping governmental agencies like the FBI and the Department of Defense combat terrorism and promote national and international security.

As part of the project, the FBI recently funded Carnegie Mellon and UNCW researchers a total of $850,000 for a year's worth of research into the development tools needed for forensic face identification. Overall, Ricanek estimates that the facial recognition program could bring in as much as $1 million in grants during the 2009-10 school year. Although grant money has become scarce in the recessive economy, Ricanek predicts that the field will continue to stay strong and that UNCW's involvement will grow.

"The FBI has this huge initiative to collect biometrics for every person in the country, so we're working to develop algorithms for the face," Ricanek says.

Yet, the pervasive use of biometrics for security purposes is controversial as many people are concerned about possible misuse and/or unwarranted intrusion into the lives of law-abiding citizens.

The Craniofacial Morphological Database, or MORPH, that began five years ago when Ricanek, Albert and Patterson, working with the Wilmington Police Department, mined a public mug-shot database for images of people with multiple arrest records, now holds more than 100,000 images. It is the world's most extensive longitudinal library of facial images.

To support all of its efforts, the facial recognition program at UNCW has doubled in terms of faculty and student researchers and also external grant funding. The multidisciplinary research team now includes six faculty, two research assistants, two post-doctoral positions, three graduate students and five undergraduate students who specialize in different aspects of identity solutions: face recognition, iris recognition, age estimation and others.

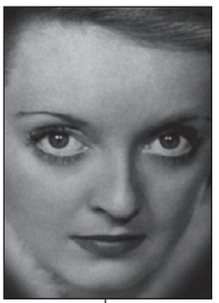
UNCW graduate students Adam Gaweda and Fernando Schiefelbein both use computer software called Active Appearance Models to map out facial features and variances. Gaweda studies how micro-gestures like blinks might be a form of lie detection, and Schiefelbein examines facial aging differences between gender and race.

Meanwhile, undergraduate students Phillip Whisenhunt '10 and Ricardo Valea '10 are focusing on iris recognition. Whisenhunt is working to develop mathematical equations and algorithms that assist with iris recognition, and Valea has been working on the hardware (cameras and iris scanners) needed for recognition. One day, these devices could be employed in iPhones and other mobile devices to help with security measures.

"We've learned a lot, we've developed some really cool algorithms, and we still have a long way to go," Ricanek says.

Their work in biometrics – the measurement of living traits with accurate prediction of idiosyncratic aging – is cutting edge. From network security to identity theft to border control, predictability of identity across time offers the best hope for secure authentication, and UNCW is leading the research that will deliver that security. ▪

— Ron Vetter, professor of computer science, contributed to this article.



Actress **Bette Davis**

"I thought it was an **important problem** to work on, and it would be something that could help me establish an **active research program** here at UNCW. I did not anticipate the complexity of the problem – nor did I think that we would, five years later, be considered one of the **world's experts** in this area."

– Karl Ricanek, Jr.

Biologist **Larry Cahoon** looks for gold in hog waste.

Waste Not Want Not

Researchers' Discoveries Set to Revolutionize Hog Waste Management

BY BRENDA RIEGEL

"If we discovered gold in hog waste, we wouldn't throw any of it away." Half a dozen years ago, UNCW biologist **Larry Cahoon** made this prophetic statement at a Canadian three-province conference that brought together agricultural waste managers from Alberta, Saskatchewan and Manitoba.

While it is not gold, a bacterially produced carotenoid pigment found in some hog waste lagoons may prove to be very valuable indeed. Carotenoids are the pigments that make carrots orange, tomatoes red and flamingoes, as well as certain hog waste lagoons, pink. Carotenoids also may improve human health by acting as antioxidants, working to protect cells and tissues from the damaging effects of free radicals and other elements. The particular carotenoid that Cahoon and co-researchers microbiologist **B.K. Song** and chemist **Chris Halkides** have isolated in pink lagoons may be valuable enough, in fact, to revolutionize the management of waste in the state's pork-producing industry.

It's hard to find people with neutral opinions about hog farming.

For some, it stinks – literally and metaphorically. The stench from hog waste lagoons remains one of the major criticisms of the industry. The danger of nutrient-rich lagoons overflowing into water supplies is another concern.

For others, however, the smell one catches a whiff of along eastern I-40 is simply the smell of money.

It's hard to argue with the latter. Pork production experienced exponential growth in the 1990s, fueled in part by the decline of other agricultural products, including tobacco.

Pork production is big business. According to the N.C. Pork Council, more than 18 million pigs were marketed in the state for a value of nearly $2 billion in 2006. The total economic impact for North Carolina of pork production that year was estimated at just shy of $7 billion in retail and value-added sales and more than 46,000 full-time jobs.

Eighteen million pigs create a lot of jobs and a lot of waste. According to Cahoon, there are more than 2,300 hog waste lagoons in the state. Pink lagoons make up about half of that total. The other lagoons are mostly dark brown or black, and a few are yellowish-green. Pink lagoons are far less oderiferous than their darker-hued counterparts. This is a plus to hog farmers, and a godsend to their neighbors.

"The problems with odor arise from the pressures that farmers experience. The waste belongs to the farmer. Unless there is profit in waste, there is a tendency to cut corners," Cahoon says.

The color of lagoons depends on the inputs. With the right ratio of animals to lagoon volume, farmers end up with a pink lagoon, which also is a lagoon that, according to Cahoon's findings, produces this intriguing carotenoid. When the ratio is

UNCW/JAMIE MONCRIEF

off – too much waste from too many pigs in too small a lagoon – farmers end up with a smellier lagoon without this and other valuable, naturally produced by-products.

Cahoon's initial interest in the promise of pink lagoons began in the fall of 2005. In 2008, he received grant funding for this research for one year from the UNC General Administration Research Competitiveness Fund and just recently for three years from the North Carolina Pork Council for total awards of $191,507. With the support of these funds, Cahoon, Halkides and Song isolated the antioxidant-producing bacteria and are now are completing their evaluation of the pink carotenoid. Their results show the bacteria also are producing other useful compounds, such as vitamin B_{12}.

"If we can extract potentially valuable by-products, we can market them; and we will have a financial incentive for better hog waste management," Cahoon says. "We need absolute numbers. Is it worth moving to the next level – commercializing the products?"

For comparison, Cahoon noted that Lycopene, another carotenoid linked to prostate health, sells for approximately $50,000/kg.

"Pork producers are really excited about this," he says. "They see the potential for solving a number of problems, maybe all at once."

These solutions may arise from Cahoon's vision to see lagoons as essentially bioreactors – a source of many beneficial natural products. "It's actually not 'waste,' it's a potential resource," Cahoon says. "It's all about how you manage lagoons. A win-win is odor control and the extraction of natural products."

It is a win-win that the industry needs. Feed accounts for the largest portion of the production cost of pork, and feed prices have as much as quadrupled in recent years. Without other ways to produce revenue, like selling waste from the lagoons for other purposes, farmers will have to raise prices to the consumer.

According to Cahoon, "Hog producers could use a new revenue source. With current economic conditions and the fallout from the H1N1 virus, farmers are actually losing money on every hog right now."

Better waste management also is costly. Cahoon and environmental studies professor Robert Cutting estimate it would cost $150 million to $200 million to convert the lagoon operations to more advanced systems in North Carolina alone.

"So who's going to pay for it?" asks Cahoon. "State taxpayers can't pay for it. An industry losing money can't pay for it either. The economics of the situation say we're going to be stuck with this for some time.

Professor of biology **Larry Cahoon** samples the water at a pink lagoon in Pender County.

However, if we convert hog waste to a source of revenue, maybe we can use that to fund the enhancements."

"If we can extract these valuable carotenoids and other compounds from hog waste, its management will change radically. It becomes a win-win-win situation for everyone in the state. Farmers win, consumers win and the environment wins," says Cahoon. ▪

UNCW's role in the collaborative bio–monitoring program is to collect the highest quality data possible on marine mammal and sea turtle distribution in Onslow Bay.

WATCHING OVER ONSLOW BAY

BY LINDSAY KEY '11MFA

Eight hours in a really loud Volkswagon: that's how UNCW biologist **Ann Pabst** describes flying in a twin-engine plane 1,000 feet above the Atlantic Ocean. Pabst and research associate **Bill McLellan** direct UNCW's aerial survey program that is housed in the Department of Biology and Marine Biology.

From the skies, they and their research team of specially trained observers are monitoring the distribution, abundance, habitat use and seasonal movements of marine mammals and sea turtles over a 1,700 square kilometer area in Onslow Bay – an indentation of the North Carolina coast that is part of the open Atlantic Ocean.

UNCW is a member of a consortium of three institutions collecting the highest quality data possible on marine mammal and sea turtle distribution in Onslow Bay. Duke University, also a consortium member, monitors the same area using vessel surveys. These data are then shared with researchers at the University of St. Andrews in Scotland, who calculate the density of animals based on the combined aerial survey results from UNCW and observations at sea from Duke. The aim of the effort is to learn as much about the environment as possible because the Navy may use these waters to conduct undersea warfare training.

"It is important to do this type of work so that we can know more specifically what species live here and how they use the area seasonally," says Joel Bell, marine protected species biologist with the U.S. Navy. "It serves an environmental planning need and fulfills a regulatory compliance requirement."

The Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973 require the U.S. Navy to monitor an area prior to conducting anti-submarine warfare training there. "Ships, helicopters and airplanes use sonar to find submarines," Bell says.

"Because marine mammal stranding events have been known to occur in temporal and spatial association with military sonar exercises in the past, there is a need to understand how these species utilize local waters," Pabst says.

A stranding is the beaching of a live or dead marine mammal. For 30 years, Pabst and McLellan, national stranding experts, have researched marine mammal strandings to better understand and prevent these events.

Pilot Ron Schreck of Orion Aviation assists **Ryan McAlarney**, UNCW research specialist. The U.S. Navy monitoring plan requires that only marine science professional who are experts in their field collect data.

This day on the job, at a small terminal at the Wilmington International Airport, two safety-trained researchers, Peter Nilsson and Ryan McAlarney – UNCW biologists who work with Pabst and McLellan – board a specially equipped Cessna 337 Skymaster twin-engine plane, provided by Orion Aviation of Siler City, N.C., to monitor Onslow Bay. The reconnaissance plane, chosen for its ability to fly at slow speeds, is tight quarters for the two researchers and two specially trained pilots on a four-to five-hour journey that is not for the weak-stomached.

When McAlarney or Nilsson spot an animal or group of animals, they ask the pilots to circle so they can take photos to identify the species and make notes on their movements. The plane's tracking system allows them to pinpoint the exact geographic location where the sighting occurred – data that is critical for determining abundance and distribution patterns over time. From the ground, McLellan tracks their progress through a Web-based GPS monitoring system.

"It will show on Bill's screen that we went off to the right or that we're circling around something and then note that we're back on the track line and we're flying straight," McAlarney says. "Flying that far offshore, it's good to have multiple people keeping an eye on things."

So far, according to Pabst, bottlenose dolphins and spotted dolphins are the most commonly encountered species they have surveyed in the region. Risso's

Aerial survey observations over Onslow Bay will be used to design measures to protect the 43 marine species of concern that occupy the waters off the coast of North Carolina – including endangered and protected marine mammals and sea turtles.

dolphins, short-finned pilot whales, and rough-toothed dolphins have also been observed but more rarely.

All results are shared with the U.S. Navy, which is also monitoring an area off the coast of Jacksonville, Fla. Bell thinks that the Floridian location may become the preferred place to conduct the training for several reasons, but "we felt the data being collected in Onslow Bay was very valuable and could benefit us overall … so we are continuing to fund that work as part of the larger Navy monitoring program in both the Pacific and Atlantic."

When the eight-year monitoring project, now in its second year, is complete, a definite location for naval training will be chosen. The U.S. Navy will then begin to install a network of "nodes" on the sea floor to monitor and evaluate a variety of anti-submarine warfare training exercises.

"It will take some more time before we have enough data to say much, but we are definitely making progress and doing some very interesting work," Bell says. "Eventually this will contribute to informing the Navy and the National Marine Fisheries Service about the species that live where we plan to train and allow us all to do a better job of assessing potential impacts."

The UNCW Marine Mammal Stranding Network involves between 75 and 100 undergraduate and graduate students and citizens from the region each year in work to understand strandings. Annually, about five to 10 self-selected students receive in-depth stranding experience.

Pabst, McLellan, Nilsson and McAlarney are pleased to be involved with the research because the data collection mission also complements their long-term research on the North Atlantic right whale, *Eubalaena glacialis*.

Right whales are the most endangered large whale in the North Atlantic – estimates indicate as few as 400 right whales may be left in the world. During the summer months, these whales typically feed in the waters off Canada and New England before migrating south to calve off the coasts of the Carolinas, Georgia and Florida. Right whales can be identified individually, McAlarney says, by the pattern of callosities on their heads. These irregular skin patches, which harbor a special kind of whale lice, make it possible to identify these individual whales via photographs.

Past UNCW research surveys, funded by the National Oceanic and Atmospheric Administration (NOAA) on right whales in the mid-Atlantic are being combined with the data collected on this project to help build a long-term picture of these and other marine mammals that inhabit North Carolina waters. ▪

— Kim Proukou '06M contributed to this article.

From 1999 to 2002 and 2005 to 2007 NOAA has supported UNCW research employing aerial surveys of marine animals – bottlenose dolphins, humpback whales, right whales – in the mid-Atlantic. U.S. Navy support at the proposed U.S. Undersea Warfare Training Range (USWTR) has spanned years 1998, 2006, 2008 and 2009. This article describes the current UNCW role in USWTR Long-Term Monitoring Program. Presently, researchers from UNC Wilmington, Duke University and the University of St. Andrews, Scotland, collaborate on this project. During this time, 10 honors undergraduates, 14 master's students, two Ph.D. students and two post-doctoral fellows have carried out their research in the lab.

Note: All marine mammal images used in this story were collected by UNCW Marine Mammal Program under NOAA permit.

FINDINGS

UNPRECEDENTED BREVISIN

By Kim Proukou '06M

Floating suspended in the water column, on or near the marine surface, tiny organisms paint the seas blue to black to green according to their concentration. Only a microscope reveals these exquisite structures that refract light like exotic jewels suspended on the neck of ocean waters. They are phytoplankton algae. They have no land-based equivalent – and unlimited structural potential.

With an evolutionary history much longer than humans', phytoplankton communities have survived because of the extraordinary chemistry they make. Dinoflagellates, a subclass of phytoplankton, are among the most powerful chemical factories in nature. Now, revelations of the mechanics and properties of dinoflagellate cell walls are opening up new employment opportunities for these dynamic organisms in biopharmaceutical research and development.

At UNCW's Center for Marine Science (CMS), researchers are focusing on phytoplankton subclasses to design drugs with enhanced pharmacological properties. "The term is unnatural natural products," says **Jeffrey Wright**, coordinator of the Marine Biomedical/Biotechnology Program at CMS. "We can tinker with the biosynthetic machinery to get it to produce novel biological activity and forge new directions in pharmaceuticals."

Wright and his team's discoveries demonstrate the unique bio-synthetic capabilities of these organisms. In July 2008, researchers revealed an unprecedented monocyclic ether alkaloid named brevisamide*, derived from the dinoflagellate *Karenia brevis*. Brevisamide's simple chemical structure particularly lends itself to replication and diversification, suggesting capabilities that may surpass the performance of brevenal.

"Because we can grow organisms here and grow them repeatedly – forever if we wanted to – it is possible to profile all the compounds an organism can make," Wright says. "It is like putting together a family tree: who beget whom." And for each of these 'begets' there is probably a pharmaceutical application? "Yes, we think so."

A distinctive feature of the chemistry of dinoflagellates is the number of compounds they can produce. Just last year, the group was able to isolate more than 20 compounds from just a few organisms.

However, the group at CMS does not work on just one organism or group of organisms. They pursue a number of directions. "We hold about 10 arrows in our quiver at a time," Wright says.

Wright and the team of **Masayuki Satake**, postdoctoral student **Anna Campbell**, **Ryan M. Van Wagoner**, **Andrea Bourdelais**, **Henry Jacocks** and **Daniel Baden** recently isolated another unprecedented structure from the dinoflagellate *Karina brevis,* named brevisin. The discovery was published in the American Chemical Society's *Journal of Organic Chemistry* Jan. 5, 2009, and recommended for special mention in *Chemical and Engineering News*. This first finding has implications for future drug design of fused-ring, or ladder-frame, polyether systems: systems that are unusually pliable.

"We are beginning to understand how these organisms make compounds naturally," Wright says. "From this understanding we can make pharmaceuticals biosynthetically. We can give the organisms building blocks, 'precursors,' as we call them, and see what the organisms make of them – extracting their metabolic potential.

UNCW/JAMIE MONCRIEF

"We want to understand these exotic structures," says Wright, "What are the Lego bricks it uses to build them? We want to get into the genetics of the process to be able to modify the compounds and create new directions in the discovery of new pharmaceuticals."

More than 50 percent of the drugs in the United States are derivatives of natural products, grown – not harvested – and produced in the laboratory using processes like those demonstrated by researchers at UNCW's Center for Marine Science.

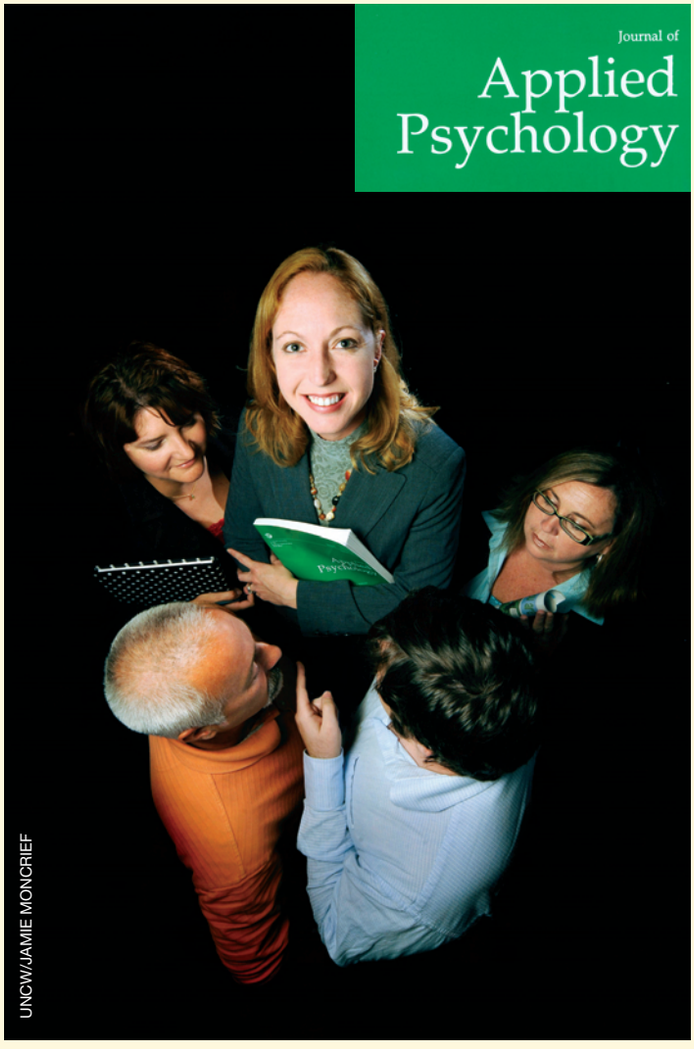
Genetically targeted for unprecedented effectiveness, these drugs also represent a new green biotechnology that is not only cost-effective but, most importantly, a highly efficient approach targeted at developing new medical treatments. ▪

***End Note:**
The team that uncovered brevisamide was visiting scientist **Masayuki Satake**, **Andrea Bourdelais**, **Ryan M. Van Wagoner**, **Daniel Baden** and **Jeffrey Wright**, team leader. Using detailed MS (mass spectra) and NMR (nuclear magnetic resonance spectroscopy) spectral analysis, their report describes the simplest structure yet to be derived from *Karenia brevis.*

MEETINGS THAT MEAN BUSINESS

By Kim Proukou '06M

Today, when decision-making is delegated to teams rather than managers, leaders rely on meetings to be the flash points of organizational momentum; but does the expectation deliver?



UNCW/JAMIE MONCRIEF

In the March 2009 issue of the *Journal of Applied Psychology*, lead author and Cameron School of Business assistant professor of management **Jessica R. Mesmer-Magnus** and Leslie A. DeChurch of the University of Central Florida, both organizational psychologists, published a meta-analysis of 22 years of research, integrating 72 separate studies – involving 4,800 groups and more than 17,000 people – on the effect of information sharing on workplace team performance. Their research has both recovered valuable insights and stimulated further investigation.

Typically, teams possess an informational advantage over individuals. But to realize that advantage, teams must demonstrate that they value the unique expertise, experience and viewpoints of each member. For example, earlier statistical research (Stasser & Titus, 1985) demonstrated the negative consequences to organizational decision-making when even one team member withholds a unique opinion. Magnus and DeChurch were able to extend that consequence – finding that effectiveness and quality of decision-making suffers even when the single withheld opinion is flawed or incorrect.

A Controversial Finding

Contrary to common belief, diversity of team members does not automatically ensure diversity of opinion. In fact, in organizational cultures where consensus is overvalued and unique opinions under supported, members from diverse backgrounds are actually less likely to share their unique insights.

"Diversity is an asset only when uniqueness is truly valued and encouraged," Magnus says. "The strongest predictor of team success is the recurrent, open offering of unique opinions and insights."

The Role of Structure

Magnus emphasizes the importance of structuring meetings and team discussions to bring out unique opinions. When both organizational purpose and unique opinions are sought and esteemed, better decisions follow.

"Unstructured discussion often serves to strengthen individual pre-discussion preferences rather than set the stage to share and receive new information from diverse members," Magnus says. Findings show that structuring team discussions enhances information sharing.

The Challenge

Teams exceed expectations for creative problem-solving when they can accomplish two things: a level of quality socio-emotional functioning that permits open sharing and a demonstration of acceptance that encourages each member to share unique opinions. Magnus hopes "that further studies will explore uniqueness and open information sharing in combination."

What We All Want

"We all want validation when we are in groups," Magnus says. "But because we are all so different, we may seek common ground by repeating the same, safe information, thinking we are gaining ground and acceptance." However, repeating known-to-be-acceptable information merely prolongs meetings and increases the chance that the team will reach a poor or under-informed decision.

If teams and organizations can set the table with enough varied information "to properly examine alternatives and choose relevant criteria," Magnus says, "they will expand their pool of information and reach better decisions." However, findings confirm that most often, "teams fail to share that kind of information when they most need to do so."

Structure Counts

A preventative solution to nonproductive meetings is to structure them so that each member is encouraged to share the unique information and viewpoint they hold. By framing team tasks as true investigative, intellectual endeavors – not joint approvals of communal tastes and instincts – and by promoting a cooperative – not competitive – environment, organizations can improve their information sharing and make better decisions.

Magnus offers some simple suggestions:

- Leaders set the norms and have the responsibility for the structure of meetings and the overall success of the group.
- State the protocol for the meeting to uncover the unique information and diverse viewpoint that each member brings to the discussion.
- Offer individual and team-level awards to provide the best incentive for greater productivity.
- Use a combination of communication methods, telephone, personal visit and e-mail to confirm and support intake of unique information.
- Use e-mail to increase the collection of unique information before and after meetings.
- Follow up a virtual meeting with face-to-face interaction.
- Follow up telephone conversations with e-mail.

Magnus says, "Remember, brainstorming enhances creativity. Be brave enough to throw out the wild idea. Everyone should know that there is time to polish suggestions later."

And finally, regardless of what is left unfinished or unsaid – when a meeting has gone on too long, a consensus will develop to end it. ▪

Dr. Jessica Mesmer-Magnus' research interests include work/family conflict, team cognition and communication, whistleblower retaliation and counterproductive work behaviors.

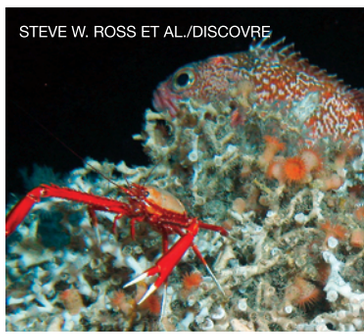
She was invited to present a prior version of her publication at the 2008 Society for Industrial and Organizational Psychology Conference in San Francisco, Calif. as part of a 'Best Papers' symposium.

CIOERT: A NEW COOPERATIVE INSTITUTE FOR EXPLORATION, RESEARCH AND TECHNOLOGY

By Kim Proukou '06M

UNC Wilmington and Harbor Branch Oceanographic Institute at Florida Atlantic University (HBOI/FAU) are partners in a new multi-million dollar NOAA-sponsored cooperative institute. In March 2009, new legislation authorized NOAA's Ocean Exploration and Research Office to administer the merger of OER and the National Undersea Research Program (NURP). The cooperative institute structure replaces the regional NURP National Undersea Research Centers on the East Coast.

UNCW and HBOI/FAU will share responsibility for the new *Cooperative Institute for Ocean Exploration, Research and Technology, CIOERT* – pronounced "sigh-ert." Shirley A. Pomponi of FAU is executive director and principal investigator (PI) and **Daniel Baden**, director of the Center for Marine Science at UNCW, is co-PI and the managing director.



STEVE W. ROSS ET AL./DISCOVRE

Four research themes will focus CIOERT efforts for the next five years:

- Developing advanced underwater technologies
- Exploring shelf frontiers
- Protecting vulnerable deep and shallow coral ecosystems
- Outreach and education

UNCW and HBOI/FAU responsibilities cover the Great Lakes and the eastern seaboard from Canada to the Gulf of Mexico and include the Caribbean, the eastern U.S. Exclusive Economic Zone, the majority of the nation's wetlands, the only emergent living coral reef ecosystems off the continental U.S. and the nation's most valuable offshore oil and gas resources. UNCW will continue to manage the Aquarius Reef Base undersea research laboratory.

As a cooperative institute, CIOERT is a NOAA partner. As a managing partner, UNCW will gain access to intramural funding for new projects, a status that will facilitate financial support – quickly and directly – enabling CIOERT to fulfill its mission: to transform the way the ocean is explored through innovation at every level of endeavor.

CMS/UNCW and HBOI/FAU bring a shared record of decades of ocean exploration, operational expertise and research and technology development. At CMS, marine technicians, field and engineering specialists bring the same intensity and attention to detail to single-focused investigations – that need "to get that worm and bring it back alive" – as they do to the most sophisticated complex marine expeditions, says **Andrew Shepard**, CIOERT associate director. "We don't end with peer-reviewed publications or prototype technologies. We work to apply and transition discoveries and innovations to our stakeholders, including our NOAA partners."

Experts at putting men and machines beneath the sea, CIOERT technical and operational capabilities include diving and ship operations such as UNCW's mixed gas scuba program, the UNCW-operated Aquarius Reef Base, HBOI/FAU's *R/V Seward Johnson* and the Johnson-Sea-Link submersible and UNCW research vessels, *R/V Seahawk* and *R/V Cape Fear*, as well as robotic remotely operated vehicles and autonomous underwater vehicles owned and operated by both institutions.

The five-year plan includes objectives to train the next generation of scientists and technologists, educate the public on the importance of sustaining the health and productivity of our oceans, promote K-12 ocean education and realize the benefits of new products from the sea, particularly in the area of biomedical research.

Limited partners SRI International and the University of Miami (UM) will be key to achieving goals and objectives. SRI will provide engineering, modeling, simulation and analysis, software support, training in measurement, instrumentation, testing and evaluation. UM will offer the strengths of its Cooperative Institute of Marine and Atmospheric

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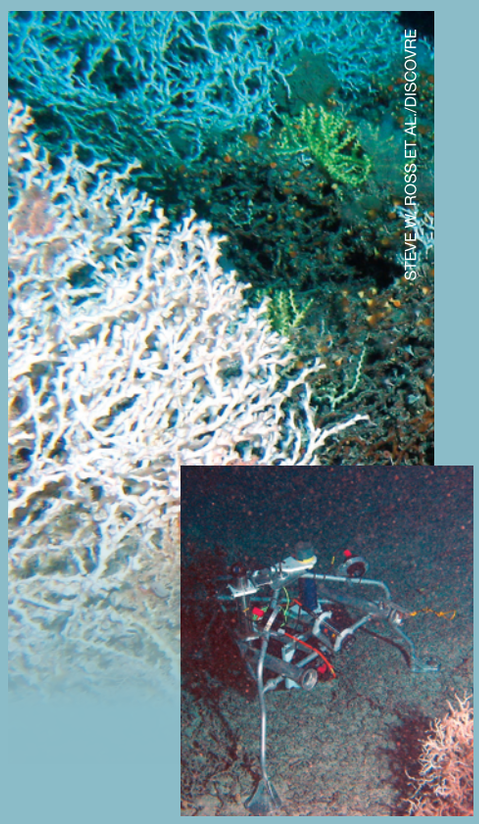

New undersea technologies aid in exploring deep-sea environments that hold the promise of new scientific and medical discoveries; however, if these habitats are disrupted, their pharmaceutical and other potential benefits may be lost.

Studies that include remote-sensing/habitat mapping capabilities and advanced optical and acoustic biological sampling technologies for recruitment and connectivity research – research that investigates the population dynamics of marine animals and plants in sea and coastal environments – and for coral reef monitoring.

The Blue Frontier

The oceans provide more than 90 percent of the space on Earth – a vast frontier that shifts and moves in time and space. New technologies that CIOERT will develop and support will help researchers predict when and where shifting ocean habitats change and how species use multi-layered depths and seafloor habitats to protect themselves.

CIOERT will assist NOAA with the required exploration and research needed for informed decision-making. For example, mapping of deep marine protected areas will help resource managers conserve and protect essential fish habitats from growing natural and human threats.

CIOERT's universities will also offer superb education and training opportunities for their students, both undergraduate and graduate. As part of the cost-share and in support of CIOERT grant activities, UNCW will be able to support two postdoctoral fellows. In addition to participation in research cruises and expeditions, students will be trained in the "discipline of innovation," a foundational concept of CIOERT.

Note: "The Discipline of Innovation" was the title of an article by Peter F. Drucker that first appeared in the Harvard Business Review's *May-June 1985 issue adapted from Drucker's book* Innovation and Entrepreneurship: Practice and Principle *(Harper & Row, 1985). Reprinting the article in 1998, HBR editors made this comment: "…innovation is the responsibility of every executive, and it begins with a conscious search for opportunities… Finding these opportunities – and exploiting them with focused, practical solutions…"*

Being alert to opportunities especially when expectations fail, keeps executives – or researchers, students and other investigative minds – open to resourceful applications and solutions.